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TITLE: Female Reproductive Effects of Exposure to Jet Fuel at
U.S. Air Force Bases

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FOREWORD

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Grace Semasters 11-14-97
PI - Signature Date

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Introduction:

Female military recruits are usually young, inexperienced and unsophisticated in their understanding of the potential for adverse health effects associated with workplace exposures. They may, however, be at risk both for acute health problems such as menstrual disorders as well as acute or chronic long-term effects associated with exposure to agents known to be neurotoxic, mutagenic, carcinogenic or to be reproductive toxicants.

A. Jet Fuel Types and Usage

One of the most common chemical exposures at all Air Force bases is jet fuel (JF). JF consists of a variable mixture of hydrocarbon compounds whose specifications are based on burn characteristics, and additives used to inhibit icing, corrosion, and static. JP-8 is a turbine engine fuel recently replacing JP-4. It constitutes at least two thirds of the turbine fuels used by the Department of Defense (DoD). JP-8 is a kerosene-based distillate with a higher flash point, higher chain hydrocarbons and no benzene; it is, therefore, presumed to be safer to use than its JP-4 predecessor. Use of JP-8 was recently implemented at all U.S. bases and is used at most overseas installations. Profiles for JP-8 list the following classes of compounds and % by weight excluding the additives: alkanes (43%), cycloalkanes (11%), alkylbenzenes (12%), naphthalenes (2%), dicycloparaffins, tetralins, and olefins (% not indicated). As JF is pumped to storage tanks various additives are injected containing several compounds known to be neurotoxic, genotoxic, mutagenic or reproductive toxicants. Although these additives are in very low concentrations, the workers handle large volumes of fuel, increasing exposure opportunities. For example, Tinker Air Force Base (AFB) in Oklahoma reported its 1994 purchase at a total of 14,000,000 gallons of JP-8 and JP-4 combined and Hill AFB in Utah reported its 1994 consumption at 29,000,000 gallons. In such large quantities the total of these small fractions may have substantial effects. JF also contains traces of metals and sulfur, oxygen and nitrogen compounds. **All metals through atomic number 42 except rubidium and niobium, have been found in generally low concentrations with the most prevalent metals being nickel and vanadium.** The following are approximate parts per million by weight: antimony <0.5, arsenic 0.5, cadmium <0.03, chromium <0.05, copper <0.05, iron <0.05, lead 0.09, mercury <1, nickel <0.05, selenium <0.3, vanadium <0.05, and zinc <0.05.

Both OSHA and AFOSH regulations of JF are given in terms of "petroleum distillates" (naphtha). The PEL (permissible exposure limit) TWA (time weighted average) is 400 ppm and the STEL (short-term exposure limit) (15 minutes) is 500 ppm. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a TLV (threshold limit value) for gasoline of 300 ppm with an STEL of 500 ppm. The USAF Occupational Safety and Health program has proposed guidelines for JP-8 exposure which are currently in the peer review process. The proposed guidelines set a TLV-TWA of 350 mg/m³ and a 15 minute STEL of 1800 mg/m³ and are currently under review by the Committee on Toxicology.

B. Jet Fuel Exposure: General Population

The production of military and commercial JFs in the mid 1980s was approximately 57 million tons. Exposure to JF is not limited to aviation or petroleum industry workers. As a result of normal aircraft operation, fuel may be jettisoned into the atmo-

sphere in amounts ranging from a few thousand to 50,000 liters. JFs may be introduced into the groundwater as a result of seepage from storage facilities, pipelines or from spills; JF degrades slowly and persists in soils for over 20 years. Studies of fuel contamination of soils and groundwaters have been reported and many sites are on the Superfund list. Volatilization of JF may cause high levels of fumes in the basements of homes or other buildings over the plume of the underground leak.

C. Jet Fuel Exposure at AF Bases: Results of Pilot Studies

This investigative team has a ten-year history of successful collaboration with the U.S. Air Force. Currently, this laboratory just completed a study of about sixty male military personnel involved with aircraft maintenance at Hill AF Base examining spermatotoxic and mutagenic effects of solvent exposure jointly funded by the EPA, NIEHS and the Air Force. Findings revealed that breath analysis was a far more sensitive measure of internal dose compared either to blood or urine levels of the parent compound or metabolite. Thus far it has been shown that low level exposure in fuel cell maintenance operations was associated with cytogenetic changes (Lermasters et al., 1997).

The DoD feasibility study funded for 1995/1996 entitled, "A Feasibility Study of Female Active Duty Military Personnel and Exposure to Jet Fuel", is completed. The AF Bioenvironmental Engineering Service (BEEs) supplied industrial hygiene (IH) air sampling data and matériel center transaction records. The BEEs abstracted base-wide exposure information from both the command core data base system and hard records. In addition, during feasibility study visits to Hill, Edwards, Kelly and Wright Patterson AFBs, BEE personnel familiarized study personnel with base-specific exposure zones and female staffing patterns. Specifically, contact and/or visits were made to nine bases, historical exposure data collected from seven and current ambient levels of JF for specific jobs (Air Force Service Codes (AFSCs) and Occupational Series (OSs)) obtained at four. The potential number of women exposed to JF at six bases (Edwards, Kelly, Hill, Eglin, Robins and Tinker) ranged from 16 to 146. IH personal air monitoring and walk-through evaluations were conducted at four bases (Hill, Kelly, Edwards and Wright Patterson); air sampling results are available for Hill, Kelly and Edwards. At Hill AFB ten women were assessed for possible JF exposure; seven were found to have been exposed. It is of interest that Hill AFB was still using JP-4 at time of sampling and four of the seven had measurable levels of benzene exposure. At Kelly and Edwards AFBs, there were 28 and 24 subjects, respectively, evaluated for exposure either to JP-5, JP-8 or both. Of these, seven and twelve, respectively, were positive for JFs and three and one, respectively, were positive for benzene exposure. Results of this study indicate that: 1) men and women were exposed at comparable low level exposure, and 2) cumulative exposure was associated with neurological effects in relationship to balance problems (Smith et al., 1997 and Puhala et al., 1997).

Another important finding was that subjects expressed concern about both short and long-term consequences of fuel exposure. Further, cooperation among all Base Commanders was extraordinary with **none** refusing to participate and several requesting "Briefings" on the study. The subjects also were enthusiastic about the study and gave excellent cooperation. It was of interest that some Base personnel requested to be included in this study and any future studies. **Therefore, results of the pilot study indicated that: 1) military personnel are concerned about their exposure to fuels, 2)**

concomitant exposures to hazardous compounds such as benzene were demonstrated, 3) men and women have comparable exposures, 4) neurological imbalance was associated with cumulative fuel exposure, and 5) interest and cooperation among military commanders as well as enlisted personnel were excellent.

D. Significance of Current Women's Study

The literature suggests that differences exist between genders with regard to absorption, distribution, metabolism and excretion of xenobiotics including several hydrocarbons and additives constituting JF. Anticipation of how exposures might affect women differentially requires consideration of anatomical and physiological characteristics affecting toxicokinetics such as aerobic capacity or maximum oxygen uptake and % body fat. For example, the maximum oxygen uptake for women is 57% that of men, 80% when adjusted by kg of body weight. When adjusted by lean body weight, the maximum oxygen uptake for women more closely approximates 91% that of men. Changes during pregnancy in body weight, plasma proteins, plasma volume, body fat, cardiac output, extracellular fluid volume and total body water generally increase xenobiotic distribution. Minute ventilation, for example, increases by nearly 50% over the nonpregnant state. Increased blood flow to regions of the body during pregnancy, especially to the hands, may enhance dermal uptake. Parameters that may alter distribution and affect xenobiotic concentrations include plasma volume, total body water, plasma proteins, and the status of the cardio-pulmonary system. While initial distribution of a toxicant is regulated by blood flow, tissue concentration is determined by affinity. **Because of women's high fat to body mass ratio, lipophilic xenobiotics are distributed differently resulting in a relative increased body burden within the fat compartments.** Most component alkanes and alkenes in raw JF are lipophilic, and are sequestered in adipose tissue that can be mobilized with increased metabolic demand, e.g., strenuous activity or during pregnancy.

Important xenobiotic response determinants are the residence time in tissue, and metabolism which primarily occurs in the liver, but also in the lung, kidney, intestinal tract and skin, as well as placental and fetal tissues. Lipid solubility, protein binding, dose and route of exposure affect the rate of biotransformation. Average basal metabolic rates are lower in women. Adipose tissue metabolism differs from muscle tissue, contributing to women's generally slower metabolic rate. The ultimate rate of biotransformation depends upon the toxic activity of the parent compound and/or the products of metabolism. The majority of xenobiotics are eliminated by renal, hepatic or pulmonary routes. Renal blood flow, glomerular filtration, tubular secretion and tubular reabsorption are greater in men than in women. Elimination may be altered during gestation. **Therefore, women may be more susceptible to JF exposure due to increased percent body fat, lower basal metabolic rates, unique reproductive functions and physiologic changes associated with pregnancy.**

In summary, fuels are mixtures of over 250 compounds. The pharmacokinetic patterns and toxic effects on the human reproductive system are largely unknown. For multiple and complex exposures. Toxic exposures can alter hormonal and menstrual patterns by a number of mechanisms including inhibition or damage to ovarian follicles, effects on the CNS involving the endocrine system, damage to hormone secreting organs, or disruption of the hormone balance that regulates ovulation and the menstrual cycle.

Though hormonal imbalance and menstrual disorders are generally viewed as less serious than other health endpoints, the health and financial implications of these conditions are immense. Besides personal discomfort, day-to-day disruptions and inconvenience due to chronic symptoms associated with menstrual pain and heavy flow, presence of hormonal imbalances may be an indication of the rate and severity of nonreproductive outcomes that include cardiovascular disease, endometrial and breast cancer and osteoporosis. **Severe menstrual symptoms are also associated with regular absences from work in three to 10% of all fertile women. Accordingly, the national cost estimate for missed work days due to menstrual illness for women under 44 years ranges from 94 to 308 million dollars per day missed.** Thus, hormonal and menstrual cycle biomarkers are associated with both exposures and outcomes, suggesting that these measures may be useful in the study of potential female reproductive toxicants. Closer examination of ovulatory function data will greatly improve our understanding of the "black box" of early reproductive events.

E. Hypothesis and Technical Objectives

The primary null hypothesis of this study is that there will be no statistically significant difference in hormonal patterns and menstrual function between women exposed to jet fuel and an unexposed group. The secondary null hypothesis is that there will be no significant racial differences in either internal dose or reproductive health response to JF exposure.

- A. **Technical Objective 1** - To identify and recruit 100 JF-exposed women (50 Caucasians, 50 minority) and 100 unexposed women group-matched with respect to race and age.
- B. **Technical Objective 2** - To characterize workplace exposures using occupational histories (for duration of JF exposure), personal IH exposure monitoring, and breath analysis as a measure of internal dose.
- C. **Technical Objective 3** - To determine if hormonal patterns differ significantly between the JF exposed and unexposed groups; to determine if there are effect differences between racial groups by collecting and analyzing daily urine and saliva samples.
- D. **Technical Objective 4** - To determine if prevalences of menstrual disorders differ significantly between the JF-exposed and unexposed groups; to determine if there are effect differences between racial groups by collecting three months of menstrual cycle diary information.

Body: Statement of Work Activities and Completion

There were Eight Statement of Work Activities for Year 01. This section of the report details how each activity was met and the results of each activity are supplied.

1. Develop questionnaires for collecting menstrual and occupational histories.

After a thorough review of the literature, a "Background Questionnaire for the Female Reproductive Study" was developed and pilot tested (Appendix 1). This questionnaire includes several sections:

1.	Eligibility Requirements pg (s).....	3-4
2.	Demographics pg(s).....	4-6
3.	Background Medical/Gynecological History pg(s).....	7-8
4.	Reproductive Function and Prepregnancy History pg(s).....	8-12
5.	Menstrual History pg(s).....	13
6.	Stress Related to Work and Nonwork Activities pg(s).....	14-15
7.	Life Style and Life Events pg(s).....	15-17
8.	Exposure to Chemicals pg(s).....	18-20
9.	Race/Ethnic Background pg(s).....	21
10.	Quality Control on Respondent pg(s).....	22

A "Female Reproductive Study Daily Diary" instrument was developed and pilot tested (Appendix 2). The information gathered in this instrument included the following:

1. Urine and saliva sample collection.
2. Menstrual symptoms.
3. Alcoholic beverage consumption patterns.
4. Current job activities and fuel exposure.
5. Exercise patterns.
6. Daily stress.

2. **Develop protocols for breath analysis, industrial hygiene sampling, and biological sampling.**

As shown in Appendix 3, detail protocols for all activities were developed and this is titled: "Field Study Protocols". The detailed protocols for biological sample collection is Section C, for the breath analysis it is Section D, and industrial hygiene sampling is Section E. Appendix 4 also describes the questionnaire information pertinent to the breath analysis. The most labor intensive effort for the last year was developing an extremely sensitive and cutting edge technology for collecting for low dose internal exposure levels..

Procedures: Laboratory development of the technique included configuration of the portable GC, selection and configuration of the thermal desorber, linkage of each to laptops and to each other, acquisition of equipment and supplies, and determination of several analytical parameters such as sample stability, instrument sensitivity, precision, accuracy and speed. The instrument was modified to shorten the path from the desorber to the GC, thereby minimizing the transfer time. Integration parameters were altered to recognize smaller peaks. Also, the time required for the desorption phase was decreased. Our technique was piloted as part of a jet fuel exposure study at Hill Air Force Base. The exhaled breath of 83 subjects was analyzed for benzene using our method.

The lower limit of detection for benzene in exhaled air was decreased from 50 ppb (NM 3700) to .01 ppb (and with precision, at 0.1 ppb). The GC unit has also been demonstrated to detect low levels of toluene and m,p,o-xylene.

With regard to total VOC measurement, a commercially available, portable photoionization unit to detection of ambient and breath volatile organic compounds (VOCs) has been identified. This unit has been reported to detect VOC levels as low as 1 ppm.

Biological Sample Collection:

The procedures for the collection of urine and saliva were developed by Dr. James Kesner at NIOSH. Urine and saliva collection and storage kits have been designed and prepared for distribution to study participants. These sampling kits were previously successfully implemented in a study of civilian female flight attendants. Instructions for the kits were modified based on feedback from the airline attendants. Adaptations were made to accommodate needs specific to Air Force women (e.g., arrangements for unpredictable travel schedules and a toll-free phone line for questions and comments about sample collection were specified).

3. **Pilot test questionnaire on a representative sample of women.**

The study questionnaire, daily diary, interview question and answer protocols, and an informed consent have been developed and all instruments were pilot tested.

These instruments were developed and initially pretested among female staff at the University of Cincinnati. Subsequent changes were made based on their feedback. The revised instruments were then piloted at Wright Patterson Air Force Base (WPAFB) and were reported to be both acceptable and understandable. Comments and suggestions were made by the WPAFB women regarding the wording and format for the instruments were used to refine the instruments. The updates were approved by the University of Cincinnati's Institutional Review Board (UCIRB) and the Air Force Surgeon General's Office (AFSGO). Subsequently, further revisions were requested by the Army. Both the UCIRB and AFSGO have been apprised of changes in these instruments which were requested by the Army. The Informed Consent Statement can be found in Appendix 5.

4. **Train personnel in use of breath analysis equipment and teaching participants how to collect urine and saliva samples.**

All training for the breath analysis procedures were performed by Ed Burroughs at NIOSH and Chris Newman, a Master's prepared industrial hygienist, who assisted in the development of the instrument. Dr. Kesner trained personnel on how to collect urine and saliva samples from participants.

5. **Recruit four military bases for participation in study.**

Four military bases have been recruited and have agreed to participate. These participating bases include: Hill, Nellis, Davis-Monthan, and Langley. Dates for visiting each of these bases has been established.

6. **Characterize the female populations within each selected base that are exposed and unexposed to jet fuel.**

This study seeks to include an equal number of minority and non-minority women into the study. The limiting factor has been to find a sufficient number of minority women in fuel exposed jobs meeting the age requirements of 18 to 40 years. Computerized lists were obtained for all women in the identified fuel exposed job codes for both those in military and civilian job women codes. From these lists and others the targeted number of minority, primarily African-American, women were ascertained. There are larger numbers of non-minority women available at each base and there are numerous nonexposed women meeting the requirements. The bases with the largest number of minority women with the targeted jobs are listed below with the number of African American (AA) women in parenthesis.

(7) Davis-Monthan
(3) Hill *
(9) Kelly
(12) Langley
(17) Luke
(12) Nellis
(7) Nooby
(32) Robbins
(11) Seymour Johnson
(10) Shaw
(17) Tinker

* Not largest but will be used to implement all procedures and try out all methods.

7. **Determine the optimal logistical approaches for distributing, monitoring and collecting samples and supportive material.**

The protocols available in the appendices indicate that the research team has given considerable thought to every aspect of the execution of this very labor intensive investigation. One aspect not previously described relates to recruitment of subjects. Detail methods for subject interactions are described in the Field Methods instrument of Appendix 3, Sections A and B. Basically, we work closely with the Bioenvironmental Engineering (BEES) at each base. With

this contact, a list of women, their job locations and their job phone numbers is supplied to the research team. Before the team arrives, we try to contact as many as possible potential participants, and explain the study. Recruitment continues once the research team arrives at the base.

8. Prepare year 01 screening report.

This document fulfills this goal.

Conclusions:

This research team has met all goals for the 01 year funding. In addition, new cutting edge technology has been developed in the area of quantifying internal dose levels of volatile organic levels at below 1 ppb. No other study results are available at this time.

List of Paid Personnel:

Grace K. Lemasters, PhD
Susan Simpson, MS, Project Coordinator
Donna Olsen, PhD, Research Associate
Graduate Student Helpers: (varies)

References:

1. Lemasters GK, Livingston GK, Lockey JE, Olsen DM, Shukla R, New G, Selevan S, and Yiin JH. Genotoxic changes after low-level solvent and fuel exposure on aircraft maintenance personnel. Mutagenesis 12(4):237-243, 1997.
2. Smith LB, Bhattacharya A, Lemasters G, Succop P, Puhala II, E, Medvedovic M, and Joyce J. Effect of chronic low level exposure to jet fuel on postural balance of U.S. Air Force personnel. JOEM 39(7):623-632, 1997.
3. Puhala E, Lemasters G, Smith L, Talaska G, Simpson S, Joyce J, Trinh K, Lu J. Jet fuel exposure in the United States Air Force. Applied Occupational and Environmental Hygiene 12(9):606-610, 1997.

Appendices:

APPENDIX 1

Date: ____/____/____ Time Started: ____ Time Ended: ____ Interviewer Initials: ____	I.D.: _____
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BACKGROUND QUESTIONNAIRE FOR THE FEMALE REPRODUCTIVE STUDY: UNIVERSITY OF CINCINNATI

READ INTRODUCTION: "Hello, my name is _____.
You are Ms. _____. Is that correct? I am from
the University of Cincinnati Medical Center. We are here to conduct a study of
women's reproductive health."

"We are asking you if you wish to participate in this research study. Although your
participation in this investigation is voluntary, it is very important that we obtain
the cooperation of all the employees. Before we can proceed, please take a few
minutes to read this informed consent." **HAND FORM TO WORKER.** "Your
signature will give us permission to interview you, to collect urine samples from you
before and during one menstrual cycle, and to obtain study diary information
provided by you." **AFTER WORKER HAS COMPLETED THE CONSENT
FORM, ASK** "Have you had enough time to consider the study?" **IF NO, ALLOW
MORE TIME TO REVIEW THE STUDY.** "Do you have any questions?" **IF NO,
OBTAIN SIGNED FORM FROM THE WORKER AND WITNESS WITH A
SIGNATURE. IF WORKER HAS A QUESTION, REFER TO "POTENTIAL
QUESTIONS OF RESPONDENT GUIDE".**

**"IF WORKER REFUSES TO PARTICIPATE, ASK HIM/HER "Why do you not
wish participate?" RECORD RESPONSE AT THE BOTTOM OF THIS PAGE.
THANK WORKER FOR HIS/HER TIME.**

**"Thank you for your willingness to participate. Your cooperation is very important
for the success of the study. Now we would like to ask you a number of questions
about you, your work and your medical history."
(GO TO PAGE 2)**

STATUS: INT REF ABS OTHER ("Please
explain") _____

INSTRUCTIONS FOR INTERVIEWERS:

The **INTERVIEWER INSTRUCTIONS** throughout the questionnaire are written in **CAPITAL LETTERS (IN BOLD)**. These are exclusively for your information. Do not read them out loud to the respondent.

The questionnaire has **SKIP PATTERNS** depending on the answers given or the personal characteristics of the respondent. If the skip pattern involves follow-up questions, the instruction will direct you as to which question(s) to ask next. For example:

IF YES, GO TO Q# 2-4 (continue with the next questions)

IF NO, GO TO Q#5 (skip questions two thru four & go on to number five)

If a respondent needs clarification on a given question, state only the information specified on the "Female Reproductive Study Question and Answer Sheet".

Record answers to open-ended questions verbatim. Record answers to close-ended questions by marking the appropriate box. Otherwise, record/code as:

"Don't know"

If a participant is instructed, for a given question, to answer "no" if she does not know the answer, then record "don't know" responses by marking "No ☐". If the question does not specify that a "don't know" answer is to be recorded as a "No ☐", then record "don't know" responses by hand by writing "DK"; code as "7".

Refused responses

Record refused responses by hand by writing "R"; code as "8".

Missing responses

Contact the participant for the missing information. If unable to obtain the information post-interview, code as "9".

Dates are always recorded as either **month/year** or **month/day/year**

**INTERVIEWER: READ EACH QUESTION THEN LIST THE POSSIBLE RESPONSES.
PLACE AN "X" IN THE APPROPRIATE BOX.**

READ: "the first set of questions are screening questions to determine if you have any conditions that might affect your study participation."

(#1) "Please review this list. GIVE PARTICIPANT THE LIST. If a physician has diagnosed you with one or more of the following conditions, please answer 'yes'. If the you do not have the condition or you do not know, please answer 'no'."

Yes ☐

No ☐

LIST:

Endometriosis
Chronic Pelvic Inflammatory Disease
Vaginal Cancer
Cervical Cancer
Uterine Cancer
Ovarian Cancer
Systemic Lupus Erythematosus
Hypopituitarism
Cushing's Syndrome
Sarcoidosis
Pituitary Tumor
Acute Hepatitis
HIV or AIDS
Cirrhosis of the Liver
Hypothyroidism (only if taking thyroid medication)
Hyperthyroidism
Multiple Sclerosis
Tuberculosis (confirmed by x-ray and/or sputum)
Diabetes
Have you had a hysterectomy?
Have one or both of your ovaries been removed?

(#2-9) "Do any of the following cases apply to you?"

- (2) "I currently smoke three or more cigarettes or cigars per week?" Yes ☐ No ☐
- (3) "I was pregnant within the last three months?" Yes ☐ No ☐
- (4) "I am currently pregnant?" Yes ☐ No ☐
- (5) "I have used oral contraceptives within the last three months?" Yes ☐ No ☐
- (6) "I have used estrogen replacement therapy within the last three months?" Yes ☐ No ☐
- (7) "I have used at least one of the following drugs within the last three months?" SHOW LIST: Yes ☐ No ☐
- (8) "I breast-fed within the last three months?" Yes ☐ No ☐
- (9) "I had an intrauterine device (IUD) inserted within the last three months?" Yes ☐ No ☐
- (10) "What is your.... 10a) date of birth?" Mo. / Day / Year

10b) age in years?" YEARS

(#11) "Is your race.....?"

- (A) African American ☐
- (B) Asian or Pacific Islander ☐
- (C) Caucasian ☐
- (D) Hispanic ☐
- (E) Native American ☐
- (F) Other ☐

IF OTHER, PLEASE DESCRIBE: _____

(#12) "What is your marital status?"

- (A) Never Married ☐
- (B) Married, or Have a Permanent Partner ☐
- (C) Widowed, Divorced or Permanently Separated ☐

(#13) "What is the highest educational level you completed?"

- (A) Some High School ☐
- (B) High School or GED ☐
- (C) High School + Technical School Vocat. Trng. ☐
- (D) Some College or Associate's degree ☐
- (E) Bachelor's degree ☐
- (F) Master's degree ☐
- (G) Doctorate ☐

(#14) "What was your total net family income for last year? Include any specialty pay, proficiency pay, housing and/or rations allowances. Was it..."

- (A) Less than \$15,000 ☐
- (B) \$15,000 - \$29,999 ☐
- (C) \$30,000 - \$44,999 ☐
- (D) \$45,000 - \$59,999 ☐
- (E) Over \$60,000 ☐

INTERVIEWER: IF YES TO ANY ITEM, QUESTIONS #1 OR #9, STATE: "The/your (STATE STATUS/ CONDITION) is a condition which is beyond the scope of the current study. Because of the/your (STATE STATUS/CONDITION), we are unable to include you in this investigation. We do appreciate your answering of our questions and your time, though. We do not have any more questions. Thank you!"

IF OVER AGE 40 YEARS, STATE: "This is a study of women between the ages of 18 and 40 years. We are unable to include you because of this requirement. We do appreciate your answering of our questions and your time, though. We do not have any more questions. Thank you!"

IF NO TO ALL ITEMS, QUESTIONS #1 & #10, ASK "If you should move during or after the study, we would like to know how to contact you. Is there someone, other than your spouse, who will always know where you can be contacted?"

First Name: _____

M.I.: _____

Last Name: _____

Street: _____

City: _____

State: _____

Zip: _____

Phone: (____) _____ - _____

Relationship of Contact: _____

(#15-#27) ASK: "Has a doctor ever told you that you had any of the following gynecological conditions? If you do not know, please answer 'no'."

- | | | |
|---|------------------------------|-----------------------------|
| (15) "Uterine Fibroids?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (16) "Genital tract polyps?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (17) "Cervical or uterine hyperplasia?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (18) "Pelvic Infection?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (19) "Sexually Transmitted Disease?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (20) "Polycystic Ovarian Syndrome?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (21) "Premature Menopause?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (22) "Other reproductive abnormalities
or conditions?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (22a) IF YES: " please describe" _____ | | |
| (23) "Other reproductive system surgery not
previously mentioned?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (23a) IF YES: " please describe the surgery" _____ | | |
| (24) "Were you ever treated with radiation?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (24a) IF YES: "please describe the treatment" _____ | | |
| (25) "Did your mother take DES when she
was pregnant with you?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (26) "Do you currently have an intrauterine
device (IUD)?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (26a) IF YES: " indicate month and year of insertion." _____/_____ | | |
| (27) "Have you underwent tubal sterilization?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| (27a) IF YES: " indicate month and year of procedure" _____/_____ | | |
| (28) "If you are sexually active, are you and/or your partner
currently using any method of contraception, including
male birth control methods?" | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

- (29) READ: "Do you have any other chronic medical conditions, not previously mentioned, which were diagnosed by a physician?" Yes ☐ No ☐

29a) IF YES, ASK: "Please list the condition(s)."

- 30) "Before your first Air Force job, have you ever been unable to become pregnant after one year of frequent unprotected intercourse? Frequent means intercourse at least once per week." Yes ☐ No ☐

- 31) "Since your first Air Force job, have you ever been unable to become pregnant after one year of frequent unprotected intercourse? Frequent means at least once per week." Yes ☐ No ☐

- 32) "At what age did you start menstruating?" AGE _____

- 33) "Have your periods stopped due to menopause?" IF YES, GO TO # 33a. IF NO, GO TO Q#34. Yes ☐ No ☐

33a) At what age did your periods stop?" GO TO #40. AGE _____

- 34) "When did your last menstrual period start?" PROVIDE WITH A CALENDAR _____ / _____ / _____
Mo. / Day / Yr.

- 35) "During the past three months, how many days usually have passed from the start of one period to the start of the next?" DAYS _____

- 36a) "During the last three months, were your periods regular? That is, was the length of your cycle, usually between (\pm FOUR DAYS AROUND DAYS REPORTED IN Q #35) _____ and _____ days apart?" (IF UNCLEAR, PROBE: did your cycles, which were typically _____ days, usually vary from month to month by less than four days?) Yes ☐ No ☐

- 36b) "During the last ^{twelve} months, were your periods regular? That is, was the length of your cycles usually between (\pm FOUR DAYS AROUND DAYS REPORTED IN Q #35) _____ and _____ days apart?" Yes ☐ No ☐

- 37) "During the past three months, how many days have your periods usually lasted?" DAYS _____

- 38) "Would you describe the amount of bleeding during your typical menstrual period as...?"
- | | |
|----------|--------------------------|
| Spotting | <input type="checkbox"/> |
| Light | <input type="checkbox"/> |
| Moderate | <input type="checkbox"/> |
| Heavy | <input type="checkbox"/> |

- 39) "Do you usually have menstrual bleeding or spotting between periods?" Yes ☐ No ☐

- 40) "Altogether, how many times have you been pregnant, including live births, stillbirths, miscarriages, abortions, tubal pregnancies, and a current pregnancy? IF NO PREGNANCIES, GO TO Q. #42. IF ONE OR MORE PREGNANCIES, GO TO Q. # 41.

- 41) "Thinking about your pregnancy(ies)....."

FIRST PREGNANCY:

- 41a1) "What month and year did your (first) pregnancy end?"

_____/_____
Mo. / Yr.

- 41b1) "Was it a....."

Single birth?	<input type="checkbox"/>	Miscarriage?	<input type="checkbox"/>
Multiple birth?	<input type="checkbox"/>	Stillbirth?	<input type="checkbox"/>
Tubal pregnancy?	<input type="checkbox"/>	Abortion?	<input type="checkbox"/>

IF NOT A LIVE BIRTH, GO TO 41a2 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#42. IF A SINGLE OR MULTIPLE BIRTH, ASK:

- 41c1) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

_____/_____
lbs / oz

_____/_____
lbs / oz

_____/_____
lbs / oz

SECOND PREGNANCY:

- 41a2) "What month and year did your (second) pregnancy end?"

_____/_____
Mo. / Yr.

- 41b2) "Was it a....."

Single birth?	<input type="checkbox"/>	Miscarriage?	<input type="checkbox"/>
Multiple birth?	<input type="checkbox"/>	Stillbirth?	<input type="checkbox"/>
Tubal pregnancy?	<input type="checkbox"/>	Abortion?	<input type="checkbox"/>

IF NOT A LIVE BIRTH, GO TO 41a3 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#42. IF A SINGLE OR MULTIPLE BIRTH, ASK:

- 41c2) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

_____/_____
lbs / oz

_____/_____
lbs / oz

_____/_____
lbs / oz

THIRD PREGNANCY:

- 41a3) "What month and year did your (third) pregnancy end?"

_____/_____
Mo. / Yr.

- 41b3) "Was it a....."

Single birth?	<input type="checkbox"/>	Miscarriage?	<input type="checkbox"/>
Multiple birth?	<input type="checkbox"/>	Stillbirth?	<input type="checkbox"/>
Tubal pregnancy?	<input type="checkbox"/>	Abortion?	<input type="checkbox"/>

IF NOT A LIVE BIRTH, GO TO 41a4 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#42. IF A SINGLE OR MULTIPLE BIRTH, ASK:

- 41c3) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

_____/_____
lbs / oz

_____/_____
lbs / oz

_____/_____
lbs / oz

IF ADDITIONAL PREGNANIES, CONTINUE ON SUPPLEMENTAL PREGNANCY SHEET.

41) "Thinking about your pregnancy(ies)....."

FOURTH PREGNANCY:

41a4) "What month and year did your (fourth) pregnancy end?"

 /
Mo. / Yr.

41b4) "Was it a....."

Single birth?	<input type="checkbox"/>	Miscarriage?	<input type="checkbox"/>
Multiple birth?	<input type="checkbox"/>	Stillbirth?	<input type="checkbox"/>
Tubal pregnancy?	<input type="checkbox"/>	Abortion?	<input type="checkbox"/>

IF NOT A LIVE BIRTH, GO TO 41a5 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#42. IF A SINGLE OR MULTIPLE BIRTH, ASK:

41c4) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

 /
lbs / oz

 /
lbs / oz

 /
lbs / oz

FIFTH PREGNANCY:

41a5) "What month and year did your (fifth) pregnancy end?"

 /
Mo. / Yr.

41b5) "Was it a....."

Single birth?	<input type="checkbox"/>	Miscarriage?	<input type="checkbox"/>
Multiple birth?	<input type="checkbox"/>	Stillbirth?	<input type="checkbox"/>
Tubal pregnancy?	<input type="checkbox"/>	Abortion?	<input type="checkbox"/>

IF NOT A LIVE BIRTH, GO TO 41a6 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#42. IF A SINGLE OR MULTIPLE BIRTH, ASK:

41c5) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

 /
lbs / oz

 /
lbs / oz

 /
lbs / oz

SIXTH PREGNANCY:

41a6) "What month and year did your (sixth) pregnancy end?"

 /
Mo. / Yr.

41b6) "Was it a....."

Single birth?	<input type="checkbox"/>	Miscarriage?	<input type="checkbox"/>
Multiple birth?	<input type="checkbox"/>	Stillbirth?	<input type="checkbox"/>
Tubal pregnancy?	<input type="checkbox"/>	Abortion?	<input type="checkbox"/>

IF NOT A LIVE BIRTH, GO TO 41a7 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#42. IF A SINGLE OR MULTIPLE BIRTH, ASK:

41c6) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

 /
lbs / oz

 /
lbs / oz

 /
lbs / oz

**IF ADDITIONAL PREGNANIES, CONTINUE ON SUPPLEMENTAL
PREGNANCY SHEET.**

41) "Thinking about your pregnancy(ies)....."

SEVENTH PREGNANCY:

41a7) "What month and year did your (seventh) pregnancy end?"

____/____
Mo./Yr.

41b7) "Was it a....."

Single birth?

☐

Miscarriage?

☐

Multiple birth?

☐

Stillbirth?

☐

Tubal pregnancy?

☐

Abortion?

☐

IF NOT A LIVE BIRTH, GO TO 41a8 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#41. IF A SINGLE OR MULTIPLE BIRTH, ASK:

41c7) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

____/____
lbs oz

____/____
lbs oz

____/____
lbs oz

EIGHTH PREGNANCY:

41a8) "What month and year did your (eighth) pregnancy end?"

____/____
Mo./Yr.

41b8) "Was it a....."

Single birth?

☐

Miscarriage?

☐

Multiple birth?

☐

Stillbirth?

☐

Tubal pregnancy?

☐

Abortion?

☐

IF NOT A LIVE BIRTH, GO TO 41a9 OR, IF NO IF NO ADDITIONAL PREGNANCIES, GO TO Q#42. IF A SINGLE OR MULTIPLE BIRTH, ASK:

41c8) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

____/____
lbs oz

____/____
lbs oz

____/____
lbs oz

NINTH PREGNANCY:

41a9) "What month and year did your (ninth) pregnancy end?"

____/____
Mo./Yr.

41b9) "Was it a....."

Single birth?

☐

Miscarriage?

☐

Multiple birth?

☐

Stillbirth?

☐

Tubal pregnancy?

☐

Abortion?

☐

IF A SINGLE OR MULTIPLE LIVE BIRTH, ASK:

41c9) "How much did the baby('babies if multiple birth') delivered with this pregnancy weigh?"

____/____
lbs oz

____/____
lbs oz

____/____
lbs oz

IF ADDITIONAL PREGNANCIES, CONTINUE ON SUPPLEMENTAL PREGNANCY SHEETS, THEN GO TO Q#42.

(#42-48) "In the past three months, did you have one or more of the following symptoms...? READ THRU LIST AND ✓ YES OR NO. IF YES, AND IF PREMENOPAUSAL, ASK "Was this a menstrual symptom? Include premenstrual symptoms as menstrual"

	No	Yes, menstrual symptom	Yes, non- menstrual symptom
(42) Lower abdominal cramping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(43) Aching back or thighs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(44) Bloating and/or painful breasts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(45) Headache	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(46) Nausea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(47) Loss of Appetite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(48) Diarrhea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IF NO TO ALL OF THE ABOVE IN THE PREMENSTRUAL/MENSTRUAL SYMPTOM(S), GO TO Q#54. IF YES TO ONE OR MORE PREMENSTRUAL/MENSTRUAL SYMPTOMS, ASK:

- 49) "Did you miss work in the last three months due to _____ (symptom(s))?" Yes ☐ No ☐
- 50) "Did you need to lie down in the last three months due to _____ (symptom(s))?" Yes ☐ No ☐
- 51) "Did you take any prescribed medications for your _____ (symptom(s))?" Yes ☐ No ☐
- 52) "Did you take any over-the-counter medications for your _____ (symptom(s))?" Yes ☐ No ☐
- 53) "Please list all prescribed medications that you have taken since your last menstrual period."
- NONE ☐ OTHERWISE, LIST MED'S.:

(#54 - #59) "Now we'd like to ask you some general questions related to your overall feelings of well-being. Please rate your usual feelings on a scale from zero to four for the following states." READ EACH STATE AND GIVE CARD FOR ACCOMPANYING SCALE.

	<u>If zero equals:</u>	<u>And four equals:</u>	<u>What number between zero and four best describes how you usually feel?</u>
54)	No energy	Very energetic	0 --- 1 --- 2 --- 3 --- 4
55)	No tension	Very tense	0 --- 1 --- 2 --- 3 --- 4
56)	No irritability	Very irritable	0 --- 1 --- 2 --- 3 --- 4
57)	No depression	Very depressed	0 --- 1 --- 2 --- 3 --- 4
58)	No mood swings	Severe mood swings	0 --- 1 --- 2 --- 3 --- 4
59)	No concentration	Excellent concentration	0 --- 1 --- 2 --- 3 --- 4

READ "The following questions refer to your non-work activities during the past 12 months."

- 60) "Did you have any accidental injuries when you were away from work during the past 12 months?" Yes ☐ No ☐
- 61) "Did you have primary responsibility for child care duties during the past 12 months?" Yes ☐ No ☐
- 62) "Did you have primary responsibility for house cleaning duties during the past 12 months?" Yes ☐ No ☐
- 63) "Did you have primary responsibility for the care of an elderly or disabled person on a regular basis during the past 12 months?" Yes ☐ No ☐
- 64) "During the past 12 months, did you go to school and take courses for accreditation or credit towards a degree?" Yes ☐ No ☐
- 65) "During the past 12 months, did you belong to a voluntary or religious organization at which you spent at least 5-10 hours per week?" Yes ☐ No ☐
- 66) "During the last 12 months, about how many weeks did you work more than 40 hours per week?" _____ wk(s).
- 67) "How many children four years of age or less did you have living with you during the past 12 months?" # _____
- 68) "How many children over age 4 years did you have living with you during the past 12 months?" # _____

(#69 - #80) Which of the following statements usually apply to you when you are at work?

- 69) "I have to work very hard." True ☐ False ☐
- 70) "I have to do an excessive amount of work." True ☐ False ☐
- 71) "I do not have enough time to get my work done." True ☐ False ☐
- 72) "I have to do a lot of repetitive work." True ☐ False ☐
- 73) "I have a job which allows me to be creative." True ☐ False ☐
- 74) "I have a job which allows me to learn new things." True ☐ False ☐
- 75) "I have a lot of say about what happens." True ☐ False ☐
- 76) "I have a lot of freedom to decide how I do my work." True ☐ False ☐
- 77) "I work with helpful people." True ☐ False ☐
- 78) "I work with people who take a personal interest in me." True ☐ False ☐
- 79) "My supervisor is very helpful." True ☐ False ☐
- 80) "My supervisor is concerned about my welfare." True ☐ False ☐

READ: "Have you had any unusually stressful events or experiences, which were not previously described in the past year, related to your...."

- 81) Situation at work? Yes ☐ No ☐

81a) IF YES: "please briefly describe the stressful event or experience"

82) Situation outside of work? Yes ☐ No ☐

82a) IF YES: "please briefly describe the stressful event or experience"

83) Gender? Yes ☐ No ☐

83a) IF YES: "please briefly describe the stressful event or experience"

84) Race or ethnicity? Yes ☐ No ☐

84a) IF YES: "please briefly describe the stressful event or experience"

85) "If this (these) stressful event(s) had not occurred, how different would your life be now"?

READ: Not different ☐
A little different ☐
Different in several ways ☐
Different in most ways ☐

(#86 - #90) STATE "The next group of questions are about your consumption patterns in the past two months."

86) "Have you consumed any caffeinated drinks in the past two months?" Yes ☐ No ☐

86a) IF YES, ASK: "During the past two months, how many caffeinated drinks did you usually drink or eat per day?" # _____

87) "At work, did you usually take breaks or have lunch indoors with people who were smoking in the past two months?" Yes ☐ No ☐

88) "At home, were you usually near people who were smoking indoors within the past two months?" Yes ☐ No ☐

89) "On average, how many alcoholic beverages drinks did you consume per week in the last two months?" # DRINKS: _____

READ: "The next set of questions are about recent life events. Please indicate which events, if any, have occurred within the past six months. We will then ask whether or not the event just happened, that is, within the last 30 days. Some events may have happened more than once in the past six months. If so, state the most recent time that the event happened. Some events may continue over a long period including the past six months. For these events, state the ending date. If you can't remember the exact dates, be as accurate as you can." CHECK THE BOX CORRESPONDING TO THE REPORTED TIME FRAME FOR EACH ITEM.

	A) Within 30 days:	B) 1 to 6 months ago:
90) Death of a close loved one:		
1. Mother	<input type="checkbox"/>	<input type="checkbox"/>
2. Father	<input type="checkbox"/>	<input type="checkbox"/>
3. Brother or sister	<input type="checkbox"/>	<input type="checkbox"/>
4. Husband or lover	<input type="checkbox"/>	<input type="checkbox"/>
5. Child	<input type="checkbox"/>	<input type="checkbox"/>
6. Close friend or other important person	<input type="checkbox"/>	<input type="checkbox"/>
91) Change in a relationship:		
1. Argument with husband or lover	<input type="checkbox"/>	<input type="checkbox"/>
2. Separation from husband or lover because of relationship problems	<input type="checkbox"/>	<input type="checkbox"/>
3. Breaking off of an engagement	<input type="checkbox"/>	<input type="checkbox"/>
4. A love affair outside your primary relationship	<input type="checkbox"/>	<input type="checkbox"/>
5. Husband or lover being unfaithful	<input type="checkbox"/>	<input type="checkbox"/>
6. Divorce from husband or break-up with lover	<input type="checkbox"/>	<input type="checkbox"/>
7. Getting married or returning to husband or lover after separation	<input type="checkbox"/>	<input type="checkbox"/>
8. Separation from a close friend	<input type="checkbox"/>	<input type="checkbox"/>
92) Other changes:		
1. The birth of a child or adoption	<input type="checkbox"/>	<input type="checkbox"/>
2. An unwanted pregnancy	<input type="checkbox"/>	<input type="checkbox"/>
3. A miscarriage	<input type="checkbox"/>	<input type="checkbox"/>

		A) Within 30 days:	B) 1 to 6 months ago:
93)	Work changes:		
1.	A big change at work or in school	<input type="checkbox"/>	<input type="checkbox"/>
2.	Trouble with your boss or other workers	<input type="checkbox"/>	<input type="checkbox"/>
3.	Being fired or laid off	<input type="checkbox"/>	<input type="checkbox"/>
4.	Taking an important examination	<input type="checkbox"/>	<input type="checkbox"/>
5.	Failing an important examination	<input type="checkbox"/>	<input type="checkbox"/>
94)	Illness or injuries:	<input type="checkbox"/>	<input type="checkbox"/>
1.	An illness or injury which kept you in bed for a week or more, or sent you to the hospital emergency room	<input type="checkbox"/>	<input type="checkbox"/>
2.	Hospitalization of a family member for a serious illness	<input type="checkbox"/>	<input type="checkbox"/>
3.	Attacked, raped or involved in violent acts	<input type="checkbox"/>	<input type="checkbox"/>
95)	Legal or financial troubles	<input type="checkbox"/>	<input type="checkbox"/>
1.	Trouble because of minor violations of the law	<input type="checkbox"/>	<input type="checkbox"/>
2.	Court appearance because of a serious violation	<input type="checkbox"/>	<input type="checkbox"/>
3.	Involvement in a law suit (other than divorce)	<input type="checkbox"/>	<input type="checkbox"/>
4.	Legal troubles leading you to be held in jail	<input type="checkbox"/>	<input type="checkbox"/>
5.	Financial difficulties	<input type="checkbox"/>	<input type="checkbox"/>
6.	Taking a large loan	<input type="checkbox"/>	<input type="checkbox"/>
7.	Loss of a personally valuable object	<input type="checkbox"/>	<input type="checkbox"/>
96)	Moves:		
1.	Moving of your home within the same city or town	<input type="checkbox"/>	<input type="checkbox"/>
2.	Moving to another town, city, state or country	<input type="checkbox"/>	<input type="checkbox"/>

READ: "The next set of questions concern substances you may have had contact with while on the Air Force base or elsewhere, such as during another job, hobby or at home. If you have breathed, swallowed or had skin or eye contact with any of the following substances, please answer 'yes'"

(97) "During the past three months, did you have contact with any of the following substances at or outside of work?"----->

IF YES, ASK:

"During the past?"
three months, was
your contact usually...?"

"When in contact
with _____,
what % of the
time did you
usually wear/use
...?"

A) Oil (exclude cooking oil) Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Gloves _____
Respirator _____
Protective _____
Clothes _____
Good Vent-
illation _____

B) Degreasing cleaner Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Gloves _____
Respirator _____
Protective _____
Clothes _____
Good Vent-
illation _____

C) Paint Thinner/Stripper Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Gloves _____
Respirator _____
Protective _____
Clothes _____
Good Vent-
illation _____

D) Paint Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Gloves _____
Respirator _____
Protective _____
Clothes _____
Good Vent-
illation _____

E) Varnish Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Gloves _____
Respirator _____
Protective _____
Clothes _____
Good Vent-
illation _____

F) Lacquer Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Gloves _____
Respirator _____
Protective _____
Clothes _____
Good Vent-
illation _____

G) Nail Polish Remover Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Good Vent-
illation _____

(Cont'd) ----->

IF YES, ASK:

"During the past?"
three months, was
your contact usually...?"

"When in contact
with _____,
what % of the
time did you
usually wear/use
...?"

H) Nail Polish	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Good Vent- ilation _____
I) Jet Fuel	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Gloves _____ Respirator _____ Protective Clothes _____ Good Vent- ilation _____
M) Kerosine	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Gloves _____ Respirator _____ Protective Clothes _____ Good Vent- ilation _____
J) Gasoline and other fuels	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Gloves _____ Respirator _____ Protective Clothes _____ Good Vent- ilation _____
K) Engine Exhaust	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Respirator _____ Good Vent- ilation _____
L) Pesticides	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Gloves _____ Respirator _____ Protective Clothes _____ Good Vent- ilation _____
N) Glue	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Gloves _____ Respirator _____ Protective Clothes _____ Good Vent- ilation _____
O) Natural Gas	Yes <input type="checkbox"/> No <input type="checkbox"/>	Daily <input type="checkbox"/> 1-3 x's/week <input type="checkbox"/> 1-3 x's/mo. <input type="checkbox"/> < once/mo. <input type="checkbox"/>	Respirator _____ Good Vent- ilation _____

(Cont'd) ----->

IF YES, ASK:

"During the past?"
three months, was
your contact usually...?"

"When in contact
with _____,
what % of the
time did you
usually wear/use
...?"

P) Other Solvents

Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Gloves _____
Respirator _____
Protective _____
Clothes _____
Good Vent- _____
ilation _____

Q) Smoke, other
than tobacco smoke

Yes ☐ No ☐

Daily ☐
1-3 x's/week ☐
1-3 x's/mo. ☐
< once/mo. ☐

Respirator _____
Good Vent- _____
ilation _____

98) Because there may be hormonal differences among racial and ethnic groups, we would like a brief history of your ancestry.

A) On your MOTHER'S side of the family, what race or races were your GREAT GRANDPARENTS? (IF GREAT GRANDPARENT WAS MULTIRACIAL, PROBE FOR % OF EACH RACE, AND RECORD IF KNOWN)

Grandmother's Mother: Grandmother's Father: Grandfather's Mother: Grandfather's Father:

African American	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Asian or Pacific Islander	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Caucasian	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hispanic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Native American	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Don't Know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Refusal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

B) On your FATHER'S side of the family, what race or races were your GREAT GRANDPARENTS? (IF GREAT GRANDPARENT WAS MULTIRACIAL, PROBE FOR % OF EACH RACE, AND RECORD IF KNOWN)

Grandmother's Mother: Grandmother's Father: Grandfather's Mother: Grandfather's Father:

African American	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Asian or Pacific Islander	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Caucasian	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hispanic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Native American	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Don't Know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Refusal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

INTERVIEWER'S SUPPLEMENT:

FOR THE ENTIRE QUESTIONNAIRE, HOW ACCURATE DO YOU FEEL THE RESPONDENTS ANSWERS WERE?

- 1) SEEMED COMPLETELY ACCURATE
- 2) SEEMED FAIRLY ACCURATE
- 3) DID NOT SEEM ACCURATE AT ALL

HOW COOPERATIVE WAS THE RESPONDENT?

- 1) VERY COOPERATIVE; RESPONSIVE
- 2) FAIRLY COOPERATIVE; RESPONSIVE
- 3) NOT COOPERATIVE AT ALL; UNINTERESTED; RETICENT

WERE THERE ANY UNUSUAL ASPECTS TO THIS RESPONDENT OR ANYTHING ELSE THAT SHOULD BE NOTED ABOUT THIS INTERVIEW?

APPENDIX 2

Question Booklet:
Female Reproductive Study Daily Diary

Please Keep This Booklet Throughout the Study

P g #	In this diary: - "TODAY" means 1700 (5 pm) YESTERDAY TO 1700 (5 pm) TONIGHT local time - If you do not know an answer, put a question mark (?) in the appropriate answer box		Day of the week <input type="checkbox"/>
			Today's date <input type="checkbox"/>
D i a r y S w p d	1	1. Regarding today's URINE sample:	a. What TIME did you obtain the URINE sample? (record military time)
			b. How many hours was this AFTER your previous urination? (record # of hours)
			c. What is the sample number on today's URINE vial? (record sample #)
		2. Regarding today's SALIVA sample:	a. What TIME did you obtain the SALIVA sample? (record military time)
			b. What is the sample number on today's SALIVA vial? (record sample #)
		3. Today, did you have any PROBLEMS with:	a. Urine or saliva collection? (Y = yes; N = no)
			b. Sample storage or transport? (Y = yes; N = no)
			c. IF YES to #1 or #2, please explain the problem:
		4. How many TOTAL HOURS did you SLEEP during the last 24 hours? (record total hours between 1700 yesterday and 1700 today)	
		5. Did you have a COLD, FLU, other INFECTION or FEVER of 101° or more today? (Y = yes, N = no)	
		6. Were you usually hot, warm, comfortable, cold or very cold today?	

P g #	Today, did you have any of the SYMPTOMS LISTED BELOW? (Pre stands for premenstrual)
2	7. LOWER ABDOMINAL CRAMPING? (N=no; M=yes, menstrual/Pre symptom; X=yes, not a menstrual/Pre symptom)
	8. ACHING BACK OR THIGHS? (N=no; M=yes, menstrual/Pre symptom; X=yes, not a menstrual/Pre symptom)
	9. BLOATING and/or PAINFUL BREASTS? (N=no; M=yes, menstrual/Pre symptom; X=yes, not a menstrual/Pre)
	10. HEADACHE? (N=no; M=yes, menstrual/Pre symptom; X=yes, not a menstrual/Pre symptom)
	11. NAUSEA? (N=no; M=yes, menstrual/Pre symptom; X=yes, not a menstrual/Pre symptom)
	12. LOSS OF APPETITE? (N=no; M=yes, menstrual/Pre symptom; X=yes, not a menstrual/Pre symptom)
	13. DIARRHEA? (N=no; M=yes, menstrual/Pre symptom; X=yes, not a menstrual/Pre symptom)
	IF RECORDED "M" (menstrual/Pre symptom) at least once above, answer #14 - #16; otherwise, <input type="checkbox"/> go to #17
	14. Did you need to LIE DOWN due to any of the above menstrual/Pre symptoms today? (Y = yes; N = no)
	15. Did you MISS WORK due to any of the above menstrual/Pre symptoms today? (Y=yes; N=no)
	16. Did you take prescribed or non-prescribed medication(s) for any of the above menstrual/Pre symptoms today? (Y=yes; N=no)
	17. Did you START taking any OTHER prescribed or non-prescribed medication(s) or supplements today? (Y = Yes; N = no) IF YES, please list the medication(s).

P g # 3	Reminder Note: "TODAY" means 1700 (5 pm) YESTERDAY TO 1700 (5 pm) TONIGHT local time	
	18. Did you have MENSTRUAL BLEEDING or SPOTTING today? (Y = yes; N = no go go to 22)	
	19. How many TAMPONS and SANITARY NAPKINS did you use today? (record total number of tampons + napkins used)	
	20. What was the AMOUNT OF BLOOD? (1 = spotting; 2 = light; 3 = moderate; 4 = heavy)	
	21. Did you have LEAKAGE around your pad or tampon while you last SLEPT? (Y = yes; N = no)	
	22. Did you SMOKE today? (Y = yes; N = no go go to # 27)	
	IF YES: 23. Number of CHARCOAL-FILTERED CIGARETTES smoked today? (✓if none; otherwise, record number)	
	24. Number of REGULAR FILTERED OR UNFILTERED CIGARETTES smoked today? (✓if none; otherwise, record number)	
	25. Number of CIGARS smoked today? (✓if none; otherwise, record number)	
	26. IF your BREATH was SAMPLED today, what time was your last cigarette or cigar before the sample? (record military time)	
	27. How many HOURS were you NEAR OTHER SMOKERS indoors at WORK today? (✓if none; otherwise, record hours)	
	28. How many HOURS were you NEAR OTHER SMOKERS indoors at HOME today? (✓if none; otherwise record hours)	
	29. Did you drink any CAFFEINATED coffee drinks, tea or soda today? (Y = yes; no go go to # 32)	
	IF YES: list total number of ounces (oz) of: (Do not include decaffeinated drinks)	
	30. COFFEE today? (✓if none; 8 oz. = regular coffee cup; 12 oz. = regular coffee mug)	
	31. TEA or SOFT DRINKS today? (✓if none; 8 oz. = regular tea cup or table glass; 12 oz. = mug, regular bottle or can.)	

P g # 4	Reminder Note: "TODAY" means 1700 (5 pm) YESTERDAY TO 1700 (5 pm) TONIGHT local time	
	32. How many DRINKS of ALCOHOL did you consume today (e.g., wine, beer, liquor)? (List total number of drinks; ✓if none)	
	On a scale of zero to four, please rate your FEELINGS today for the following states:	
	33. Mood swings?	(no mood swings = 0 -1 - 2 - 3 - 4 = severe mood swings)
	34. Irritability?	(no irritability = 0 -1 - 2 - 3 - 4 = very irritable)
	35. Depression?	(no depression = 0 -1 - 2 - 3 - 4 = very depressed)
	36. Tension?	(no tension = 0 -1 - 2 - 3 - 4 = very tense)
	37. Energy level?	(no energy = 0 -1 - 2 - 3 - 4 = very energetic)
	38. Please rate your ability to concentrate today. (no concentration = 0 -1 - 2 - 3 - 4 = excellent concentration)	
	39. Did you WORK at the base today? (Y = yes; N = no go go to #44)	
	IF YES:	
	40. How many TOTAL HOURS did you work today, including classes (list total hours)	
	41. What SHIFT did you work today? (D = day; E = evening; N = night; if worked a "double shift", record both shifts)	
	42. In what SHOP or OFFICE did you work today? (record shop or office)	

P g # 5	<p>Reminder Note: "TODAY" means 1700 (5 pm) YESTERDAY TO 1700 (5 pm) TONIGHT local time</p> <p>43. Did you perform an unusual JOB or JOB ACTIVITY(IES) today? (N = no; Y = yes; if yes, describe job or activity(ies))</p> <p>44. Did you SMELL FUEL in the air today? (Y = yes; N = no, go go to #49)</p> <p>IF YES:</p> <p>45. Did you SMELL FUEL while at work, outside of work, or both? (W = at work; O = outside of work; B = both)</p> <p>46. How many hours were you exposed to TYPICAL levels of FUEL in the air today? (record total hours; 0 = zero)</p> <p>47. How many hours were you exposed to HIGHER than USUAL levels of FUEL in the air today? (record total hours; 0 = zero)</p> <p>48. How many hours did you wear a RESPIRATOR today? (record total hours; 0 = zero)</p> <p>49. Did your SKIN come into contact with liquid FUEL today? (Y = yes; N = no, go go to 53)</p> <p>IF YES:</p> <p>50. Was FUEL on your SKIN while at work, outside of work, or both? (W = at work; O = outside of work; B = both)</p> <p>51. How many hours was FUEL on your SKIN today? (record total hours; 0 = zero)</p> <p>52. How many hours did you wear GLOVES OR COVERALLS today? (record total hours; 0 = zero)</p>
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P g # 6	<p>Reminder Note: "TODAY" means 1700 (5 pm) YESTERDAY TO 1700 (5 pm) TONIGHT local time</p> <p>53. How many MINUTES were you exposed to exhaust today? (✓ if zero; otherwise, record total min.)</p> <p>54. How many hours were you exposed to SOLVENTS or PESTICIDES IN THE AIR today? (✓ if zero; otherwise, record total hours) (examples: degreasing cleaner, glue, paint, paint thinner/stripper, nail polish, nail polish remover, oil, weed killer, insect killer, varnish, lacquer)</p> <p>55. How many hours was your SKIN in contact with SOLVENTS or PESTICIDES today? (✓ if zero; otherwise, record total hours) (examples: degreasing cleaner, glue, paint, paint thinner/stripper, nail polish, nail polish remover, oil, weed killer, insect killer, varnish, lacquer)</p> <p>56. How many FLIGHTS of STAIRS did you climb today? (✓ if zero; otherwise, record # of flights; assume 10 stairs per flight)</p> <p>57. Today, how many MILES did you WALK? (✓ if zero; otherwise, record miles; one mile per 12 city blocks)</p> <p>58. Today, how many total MILES did you RUN? (✓ if zero; otherwise, record total miles)</p> <p>59. Today, how many total MINUTES did you RUN? (✓ if zero; otherwise, record total minutes)</p> <p>60. Today, <u>at</u> work, how many HOURS did you do light to moderate physical activity today? (✓ if zero; else, record total hours)</p> <p>61. Today, <u>at</u> work, how many MINUTES did you do heavy (to the point of heavy perspiration or breathing) physical activity today? <i>Do not include running here</i> (✓ if zero; otherwise, record total minutes)</p> <p>62. Today, while <u>off</u> work, how many HOURS did you do LIGHT TO MODERATE physical activity today? (✓ if zero; otherwise, record total hours)</p>
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P g # 7	Reminder Note: "TODAY" means 1700 (5 pm) YESTERDAY TO 1700 (5 pm) TONIGHT local time	
	63. Today, while off work, how many MINUTES did you do STRENUOUS physical activity (to the point of heavy perspiration or breathing) today? Do not include running here (✓ if zero; otherwise, record total hours)	
	NOTE: IF YOU WORKED DURING THE PAST WEEK, PLEASE ANSWER QUESTIONS #64 THRU 75 AT THE END OF YOUR WORKWEEK	
	Please answer T = true or F = False to the following questions #64 - #75:	
	64. I had to work very hard this week? (T or F)	
	65. I had to do an excessive amount of work this week? (T or F)	
	66. I did not have enough time to get my work done this week? (T or F)	
	67. I had to do a lot of repetitive work this week? (T or F)	
	68. I had a job that allowed me to be creative this week? (T or F)	
	69. I had a job which allowed me to learn new things this week? (T or F)	
70. I had a lot of say about what happened this week? (T or F)		
71. I had a lot of freedom to decide how to do my work this week? (T or F)		

P g # 8	Reminder Note: "TODAY" means 1700 (5 pm) YESTERDAY TO 1700 (5 pm) TONIGHT local time	
	72. I worked with helpful people this week? (T or F)	
	73. I worked with people who took a personal interest in me this week? (T or F)	
	74. My supervisor was helpful this week? (T or F)	
	75. My supervisor was concerned about my welfare this week? (T or F)	
	NOTE: IF YOU ARE PROVIDING A HOME BREATH SAMPLE ON THURSDAY OR FRIDAY EVENING, PLEASE ANSWER QUESTIONS #76 THRU #79 AFTER THE SAMPLE IS PROVIDED ALL PARTICIPANTS: ON THE MONDAY MORNING THAT YOU PROVIDE A HOME BREATH SAMPLE, PLEASE ALSO ANSWER QUESTIONS #80 THRU # 83 (SEE PAGE 9)	
	76. What TIME did you collect your <u>Thursday</u> or <u>Friday</u> BREATH SAMPLE at HOME? (record military time)	
	After you left work, prior to your <u>Thursday</u> or <u>Friday</u> breath sample, were you exposed to: 77. Solvents, fuel odors or exhausts? (✓ = none; otherwise, record date & time of last exposure before your first sample)	
	78. Mouthwash, cough syrup or alcohol? (✓ = none; otherwise, record date & time of last exposure before your first sample)	
	79. Did you have problems COLLECTING, STORING OR TRANSPORTING your FIRST BREATH SAMPLE? (Y = yes; N = no) If yes, please describe problem(s):	

-FIELD STUDY PROTOCOLS -
"Female Reproductive Effects of Exposure to Jet Fuel" Study

A) Prior to Arrival at Each Base:

- 1) Inventory available supplies and equipment; order needed supplies (See "Trip Inventory Sheet").
- 2) Work with the designated Bioenvironmental Engineering (BEE) contact at each base to:
 - a) identify military and civilian jobs, i.e. Air Force Service Codes (AFSCs) and Occupational Series (OSs), held by female employees with minimum and maximum jet fuel exposure through preliminary discussion with the BEE contact; emphasize the importance of accessing a racially balanced pool of participants, i.e., 1:1 ratio of African American:Caucasian women.
 - b) gain Base Commander approval for the visit;
 - c) begin preliminary off-site phone contact with participants to introduce the study and arrange the recruitment/intake interview. If decline or are unable to schedule the recruitment interview, record the reason given.
 - d) schedule the base visit (avoid military exercise dates); ask to arrange for base clearance;
 - e) inquire of the BEE contact as to whether a briefing of key military personnel is desired; schedule the briefing with base hospital, legal, public relations and union representatives; loan slides if unable to attend our briefing, if desired;
 - f) obtain access to an office space away from fuel exposure sources with a counter or large table(s), chairs, telephone and three or more grounded electrical outlets in an area of the base as remote from fuel/solvent exposure as possible (preferably a site with an existing vacuum source and hood); request access to a fax, printer and copier.
 - g) find local accommodations and obtain directions to the base;
 - h) request that the BEE contact alert and enlist the cooperation of Shop Managers in areas to be targeted for recruitment.
 - i) if base/investigator time permits, arrange a guided base tour of shops with targeted AFSCs/OSs (including AFSCs/OSs identified with exposure to fuel during the feasibility study) at each Air Force (AF) base;
 - k) make arrangements with the BEE contact for custody of calibration gas and other supply/equipment shipments; request that they store extra study supplies. eg., extra specimen collection instructions.
- 2) Order airline tickets, a rental car, and schedule hotel reservations ASAP after study testing dates are confirmed at a given base.
- 3) Pack and ship supplies listed on the "Trip Inventory Sheet". If desorption is to be done at the base, calibration gas should be sent directly from the supplier to the base. All shipments are to be addressed to the attention of the BEE contact at each base.

B) Upon Arrival at Each Base (Days One):

- 1) Unpack supplies and equipment and assemble in the designated office. Secure gas tanks, if shipped, in tank stands or clamp to an immobile structure within the room.
- 2) Run a trial sample of the calibration gas upon arrival to test the equipment (if doing on-site sample analyses).
- 3) Conduct the briefing of key base personnel on Day One, or as soon as possible, and distribute handouts describing the study at that briefing.
- 4) After the briefing, conduct a BEE contact-guided tour of areas where women who are to be targeted for study recruitment work. Introduce AF personnel, including Shop Managers, to U.C. investigators. Offer the Shop Managers study handouts from the briefing.
- 5) Contact the stragglers not previously contacted and finalize the schedule for recruitment interviews ASAP.

C) Recruitment & Interview (Day Two and Thereafter):

- 1) Present potential participants with a brief study introduction and a copy of the "Informed Consent". Discuss the consent form with each potential participant in a private setting and answer any questions prior to obtaining signatures. If an individual declines to participate, ascertain and record the reason for refusal. Keep a secured list of participants IDs and names.
- 2) Review the "Special Measures for Study Participants" sheet with the participants; ask them to show the sheet to their household members for implementation throughout the household during the week of breath sampling. A signature is requested on the sheet. Ask that they return any signed sheets to the investigators at the time of testing. If the subject smokes infrequently, i.e., ≤ 3 cigarettes per week, ask her to refrain from smoking during the week of testing. If she has a smoker in her household, offer to discuss the smoking protocol with household smokers over the phone in order to gain their support.
- 3) Administer the screening section of the computerized "Background Reproductive History Questionnaire." Record exclusions on the questionnaire form.
- 4) If there are no exclusions, administer the remainder of the "Background Reproductive History Questionnaire". Adhere to prompts provided on the "Question and Answer" Sheet.
- 5) Ask the participant to complete forms required by the DoD, i.e. "Application and approval for off-duty employment" form (AF form 3902) – military women only, and the "Volunteer Registry Data Sheet". Note, a supervisor signature is required for form 3902.
- 6) Instruct the participant in the use of the Diary. Review each question and have the participant record answers to relevant items using the "Q&A" sheet for clarification, as required. Note: the referent timeframe is 1700 "yesterday" to 1700 "today". Answer any questions about implementing the diary.
- 7) Distribute the urine and saliva collection kits and instructions:
 - a) Materials for each woman include: one diary, one water-proof marking pen, one styrofoam chest, two freezer packs, one set of instructions for shipping samples to the Lab by Fed-X air bill, one roll sealing tape, one daily urine collection and one daily saliva collection instruction sheet, 2 urine collection boxes containing 42 labeled and capped vials and 1 metal ring, 1 plastic cup with pouring spout, one saliva box containing 84 labeled and capped vials and one plastic pearl, one pack (90 sticks) of Carefree Sugarless gum.

b) Orient the subject to vial placement and labels. Remove vials in the first row of urine and saliva boxes through today's day of the week. Participants can keep these extra vials.

c) Have them begin collecting samples "tomorrow morning", while the subject still remembers the instructions, to begin her learning curve and to assure that the samples are collected on the first day of her period. Encourage subject to remove the next morning's vial from the freezer sample box when she gets home and each morning as she puts the current morning's sample into the box. Put vial in the bathroom as a reminder and so frost on the empty vial can dry.

d) Review the instructions for collection of urine and saliva with each participant and answer any questions:

- show the subject the chart on the instructions and a calendar to clarify the sample collection period, menstrual period and menstrual cycle.

Instruct her to:

- wash her mouth with water before saliva collection and to collect the saliva before food, drink, brushing or lipstick; keep all samples frozen or, at least, refrigerated until they can be frozen;
- vial and tube caps need to be screwed on very tight; invert the urine sample three times to mix it with preservative;
- check the labels every day;
- date vials and make diary entries for all samples using the pen provided; gum is necessary for correct saliva collection and should be used and not substituted;
- do not wash beaker with soap, only water; subjects should make clear notes whenever necessary, notes are good;
- subjects should collect samples every day (if not the first thing, then ASAP). If a day is missed, continue the next day with the next vial;
- review travel instructions with the subject;
- participants need to respond to all pertinent questions every time. For example, they must indicate "no menses" rather than just leaving blanks empty;
- familiarize participants with the contact person, i.e., the BEE contact, (name, title, location, phone number) who will be on base throughout their participation. This person will provide materials such as travel thermoses and replacement supplies;
- assure participants that analyses will not check for drugs, alcohol, venereal disease, HIV/AIDS. Instruct to phone UC investigators at 1 (800) 870-0201 should questions arise during sample collection or completion of the diary;
- **emphasize** that, while proper sample collection is important, it is **essential** that they tell us what they really did, not what they were supposed to do.

- 8) Schedule participants for post-shift breath samples on the final day of their workweek, i.e., Thursday or Friday. Schedule approximately 15 participants, if possible, for each of these days. Instruct participants to phone UC on-site investigators immediately before they leave their job for the U.C. study office.
- 9) Instruct participants to phone the on-site U.C. office ASAP if they encounter an acute, high level jet fuel or solvent exposure during the week preceding breath analyses, for example, an indoor jet fuel spill.

D) Breath Sample Analysis for Benzene, Toluene & Xylenes:

Turn on the breath analysis unit and calibrate according to the following steps:

Turn on the equipment:

- a) open the carrier gas (high-purity nitrogen) line on top of the tank; the gauges on the regulator should be ~ 40 PSI to line (adjust with small black knob, if necessary) and > 500 PSI from the tank (need replacement gas when ~ 500).
- b) check the flow rate for the line proximal to the equipment; should be ~ 25 ml/min. If the flow is not ~25 ml/min, adjust the regulator accordingly (black knob on small box – a delay before flow meter reflects the adjustment).
- c) turn on the Photovac; allow to stabilize about 30 minutes – a good time to prepare calibration gases.
- d) turn on the Centura laptop and open “Windows”; select “Photovac10S+GC” icon; Under the “Analysis” bar, select “Status” and then click on the ☐ next to “Desorber Power” and wait for it to warm-up (says “Receiving Data from Instruments” (don't abort) then “System Ready” in upper left when warm – then close that box).
- e) turn on Toshiba laptop and open Windows; select “Techlink 3000/6000” icon.
- f) wait for the temperature and lamp to stabilize and watch that the flow rate stays ~ 25 ml/min.
- g) click “okay” on the Techlink message box and Techlink will self-test for two minutes.

Calibrate: at the start of testing, between every 15 tubes during testing and at the end of testing (if some parameter would happen to change between runs, e.g., flow rate, lamp fail detector off then on). To calibrate:

- a) clear the syringes and calibration breath bags of residual calibration gas with hydrocarbon free air three times; check for leaks; finally, make sure bags are completely empty then close.
- b) fill a cleaned breath bag with about 500 ml of 1 ppm BTEX gas. Attach bag to the 3/8” tank tubing, open the bag and open tank (first open on top of tank then with the small black valve closest to the bag).
- c) obtain two copper tubes and record the tube numbers and date on the calibration log sheet.
- d) prepare the calibration gas samples in clean breath bags (100 ppb and 1 ppb) as follows:

100 ppb bag: pull 900 ml of hydrocarbon-free air from the line into the 1 Liter syringe and add to a clean bag labeled “100 ppb calibration” (close bag tightly); pull 100 ml of 1 ppm BTEX from the bag using the 1 liter syringe and add to the “100 ppb calibration bag”.

1 ppb bag: pull 999 ml (~ 1000 ml) of hydrocarbon-free air from the line into the 1 L syringe and add to a clean bag labeled "100 ppb calibration" (close bag tightly); pull 1 ml of 1 ppm BTEX from the bag using the 1 ml syringe and add to the "1 ppb calibration bag".

- e) allow gases in bags to equilibrate a few minutes, and then pull each bag's contents onto a separate copper tube (double-scored end to breath bag). Use 3/16" tubing connected to 3/8" tubing (sealed with Teflon tape) to fit the breath bag to the copper tube) and a unit of 3/8" tubing connected to a port to connect the other end of the tube to the syringe; Make sure to record which tube # corresponds to 100 ppb and 1 ppb on the log sheet.
- f) first run the 100 ppb sample on the desorber. Record and save the analyte levels as usual, but also note the numbers assigned to the peaks on the graph for benzene, toluene, xylene (usually m and o-xylene curves are combined and assigned the same peak #) and p-xylene. Next, go to the Photovac 10S+GC "Method" bar and select "Library". Assign the correct peak number and calibration gas concentration for benzene and then select "Store". Repeat this process for toluene and the xylenes.
- g) next run the 1 ppb sample on the desorber. Record and save the analyte levels as usual. Do not need to reassign the peaks in the library which were based on the 100 ppb sample.

Running the calibration sample:

- a) check the flow rate to the desorber; adjust to between 20 and 25 mm Hg. (slight delay in flow meter reading after adjustment);
- b) starting with the copper tube containing 1 ppb calibration gas, remove the bolts/caps from the copper tube;
- c) attach the unscored end of the copper tube to the lower desorber connector and manually tighten the bolt; make sure the tube is all the way down in the bolt and that it is screwed tightly;
- d) add the insulating cover over the copper tube;
- e) put the upper bolt (wide end up) on the scored end of the copper tube and add the white sealer insert to the end of the tube (ridged edge up); shove the white sealer down into the bolt with the small monkey wrench; screw the upper desorber screw into the upper bolt manually then tighten ¼ turn to the right with wrenches;
- f) in Photovac 10S+GC, select "Analyzer" → "Start analysis" and then STOP after "Sample" box is highlighted in windows on the laptop connected to the Photovac; "system ready" should be visible in the upper left corner of the window; if a lamp failure occurs, it will be documented in the upper left window of the Photovac laptop screen; first, try turning the Photovac off, waiting and then turning it on again; if lamp failure message occurs again, remove the lamp from its compartment, clean its window with methanol and replace it; record any failures and corrective actions in the calibration log;

- g) if the screen reads "system ready", move to the laptop connected to the desorber and slowly click on the "Step" box until it reads "**Desorb Preheat**" then STOP;
- h) within seconds, the desorber will reach 215° C - move to the laptop linked to the Photovac at that time;
- i) **when the desorber hits 220° C, a buzzer will sound – immediately hit "S" (for sample) or enter to run the sample (MUST BE WITHIN SECONDS);**
- j) slowly click the "Step" box on the laptop connected to the desorber once to "Standby" and then STOP;
- k) check the flow rate during the desorption, but do not adjust it;
- l) when the desorber has cooled to 60° C (about 15 minutes), the copper tube can be removed from the desorber;
- m) click on "normal" to normalize the graph and examine the peaks for each analyte; record the "VS" or "mVS" of each detected analyte (benzene, toluene or m,p,o-xylene) on the calibration data sheet (the ppb information is not used); check that the names assigned to the peaks by the software program correspond to the timeframe in which the analyte is supposed to peak, i.e., 20 – 30 sec. for benzene; _____ - _____ for toluene; _____ - _____ for m, o and _____ - _____ for p-xylene. If a peak occurs within one of the above referenced intervals but is unnamed by the laptop, record this information on the calibration log;
- n) if the calibration run is invalid, i.e., if _____, then _____ should be corrected by _____;

To turn off the equipment:

- a) turn off the desorber;
- b) go to Photovac S10+ GC program and select "Status" bar; click on "Desorber Voltage" off; exit the program to "Windows", exit "Windows" and turn off laptop;
- c) close Techlink 3000/6000, exit windows and turn off that laptop;
- d) turn off Photovac;
- e) turn gas off at the tank; not using the small regulator knob.

CO₂ Indicator:

A) Equipment:

- 1) CO₂ Indicator
- 2) Black Charge Cord
- 3) Green Intake Tube

B) Setup & Calibration (this should be done once a day):

- 1) Turn switch to battery check. The screen will initially read – range: 4975PPM. The screen will then switch to indicate battery status. After a full charge (24 hours) the screen should read – E ---*- F.

2) Turn switch to cont. The screen will read warm-up. After 60 seconds the screen will initially read – CONTINUOUS MEAS – then –
– ADJ 300PPM – then – CONT xxxPPM. The meter is now directly reading CO₂ concentration.

3) To calibrate the instrument: (Switch on CONT.):

a) Take to clean-air environment and connect probe and hose assembly.

b) For Low End Calibration:

1. Fill 1 liter bag with CO₂ free air. To obtain CO₂ free-air run clean air through filter filled with glass wool, Aescarite II, then more glass wool. (CAUTION: DO NOT TOUCH AESCARITE II; IT IS VERY CAUSTIC!!)
2. Connect bag to Indicator and open valve. Move switch to CONT and read instantaneous CO₂ concentration entering probe. If Indicator is still detecting CO₂ in CO₂-free air, pull the control knob out until Indicator reads zero.

c) For High End Calibration (1000 PPM):

1. Combine 1 liter 0.5% CO₂ and 4 liters CO₂ - free air.
2. Attach green hose to sample bag, open stopcock, and allow entire bag to be sucked through Indicator.
3. While sample is being tested, adjust the SPAN screw located in a small hole on the side of the Indicator, until measured concentration matches that of the known gas.

C) Running samples:

- 1) Samples must be diluted to fall in set range of CO₂ Indicator.
- 2) Combine 990 ml of CO₂ free air, and 10 ml of sample air in a clean 1 liter bag (Be sure to put in CO₂ free air first, so the 10 ml syringe does not puncture the bag!!)
- 3) When pulling sample air, pull & push plunger 3x to clear plunger of impurities, and inject into dilution bag (use as much of the sample as possible.)
- 4) Allow bag to stabilize for 30 - 60 seconds.
- 5) Connect bag to green hose and open stopcock on bag.
- 6) CO₂ Indicator will jump around for a while, wait until it stabilizes, then record measurement.
- 7) Allow CO₂ Indicator pump to suck all of the air out of the dilution bag, as it will have to be done eventually.
- 8) Use function (FCN) key to toggle from VOC, to Benzene, to Memory screen.

10) Obtain breath samples (Wednesday, Thursday or Friday):

- a) Prepare a set of four clean Tedlar breath bag units and one clean copper tubes for each participant. Each Tedlar bag unit consists of the following components attached in the order indicated: one liter Tedlar bag → stopcock → connector tubing, dry right filter → tubing for mouthpiece with red adapter.
- b) Record the time each woman left the work site, i.e., the time of her phone call, on the "Breath Collection Log Sheet".
- c) Complete the "Work Week Prebreath Checklist". Get height and weight.
- c) Provide each woman with two clean Tedlar bags (prelabel with time, dat and id) and the mouthpiece/stopcock /tubing/dryrite unit upon her arrival. Put a "V" (for VOCs) on one bag and a "B" (for benzene, toluene and xylenes or BTX) on the other bag and record the woman's ID number on the bags. Instruct her to open the stopcock, exhale $\frac{1}{2}$ of the air, fill the bag and close the stopcock. Repeat if bag not filled. Caution her not to inhale through the mouthpiece. Collect the first breath samples (2 sample bags: one for VOC and one for BTX) within one to two hours after the woman has left the work site. For standardization purposes, try to obtain the samples as closely to one hour after work as possible. Record date and the time of the samples on the "Breath Collection Log Sheet".

Note: for the majority of women, the first sample (second compartment) will be obtained at the end of the work shift on Wednesday, Thursday or Friday (depending on their last work day) and the second and final breath samples (forth compartment) (VOCs and BTX) on Monday. For a subset of approximately 30 women, we will obtain three extra breath samples in order to establish decay curves. The initial breath samples will be obtained as closely as possible to 10 minutes after leaving her work site and again 20 minutes after she leaves the work site (samples collected within 15 minutes reflect the blood compartment). These women will also provide a third (extra) breath sample 4 to 8 hours after they leave work. For these extra compartment samples, adapt the same breath collection procedures at these intervals.

- d) During sample collection, coach the woman in obtaining the en-of-shift breath sample on her own (for practice). Obtain information about potential confounding exposures anticipated during the weekend. Problem-solve with participants to minimize potential confounding exposures and answer any questions regarding the "Measures for Study Participation" sheet. Encourage participants to record deviations from the protocol on the diary, should they occur. Recruit the subgroup of 30 jet fuel-exposed women to provide breath samples between four to eight hours after the end of their shift.
- e) Provide materials (2 remaining breath bags labeled with id and a place to record time and date), 2 foil-wrapped, filled filters (connector tubing and mouthpiece attached and ready to assemble onto breath bags), "Monday Pre-breath Sample Checklist", and a sheet of instructions for breath samples obtained at home. Stress the need to return the bags in less than four hours from the time they are filled.

- e) Pull the breath samples from the bags onto copper tubes; the tubes are good for 1 month.

Pull the Benzene, Toluene, Xylenes Breath Samples onto Copper Tubes: Breath samples must be pulled from the Tedlar bags into copper tubes within 4 hours to prevent substantial loss of analyte. Remove the breath from each bag as follows:

- a) unscrew copper tubing caps and attach the bag's tube to the double-scored end of a clean copper tube using the connector tubing;
- b) use another two-inch length of adapter tubing to connect the unscored end of the copper tube to the syringe (or vacuum source such as air sampling pump); "pull" the breath onto the sorbent copper tube by pulling 1 liter of air from the bag manually (using the syringe) or by connecting to the vacuum source (if pump is used, make sure rate is 500 ml per minute and that sample is removed in exactly two minutes for a total of one liter); alternatively, if pulling the sample using the 1 Liter syringe, wear the leather work gloves and be careful not to push air back through the tubing;
- c) tighten screwed caps on both ends of the copper tubing using the wrench (preferably) or else with caps;
- a) record the tube number and the time it was pulled onto the tube on the "Breath Collection Log Sheet"
- d) pull room air in and out of the empty syringe and sections of connector/adapter tubing in order to eliminate analyte residue between users;
- e) repeat the process of pulling the samples onto the tubes for each of the remaining breath sample bags;
- f) to clean the bags for reuse, remove the mouthpiece and infuse 1 liter of clean air through an open stopcock and then vacuum the air and close the stopcock. Repeat the cleaning process three times per bag between uses.
- g) the fiberglass stuffing and plastic shell of the filter are reusable. To reuse the filter, empty the Dryright into a garbage container and replace under a hood or outdoors (unless high humidity) in a dry area with 1 brimming tsp. (~ 6 gm) of fresh, pre-weighted Dryright using a paper funnel. Be careful not to lose any granules or to moisten the granules. Apply a new mouthpiece and make certain the outer surface is free of any fiber residue. While refilling the filters, wear rubber gloves, safety glasses and put a plastic apron over clothing to avoid fiberglass contact.

Running the breath sample:

- a) check the flow rate to the desorber; adjust to between 20 and 25 mm Hg. (slight delay in flow meter reading after adjustment);
- b) remove the bolts/caps from the copper tube;
- c) attach the unscored end of the copper tube to the lower desorber connector and manually tighten the bolt;
- d) add the insulating cover over the copper tube;

- e) screw the scored end of the copper tube to the upper desorber connector after adding the sealer insert to the bolt and then manually tighten the bolt to the copper tube;
- f) select "**Analyzer**" → "**Start analysis**" and then STOP after "**Sample**" box is highlighted in windows on the laptop connected to the Photovac; "system ready" should be visible in the upper left corner of the window; if a lamp failure occurs, it will be documented in the upper left window of the Photovac laptop screen; try removing the lamp from its compartment, cleaning its window with methane and replacing it;
- i) if the screen reads "system ready", move to the laptop connected to the desorber and slowly click on the "**Step**" box until it reads "**Desorb Preheat**" then STOP;
- j) within seconds, the desorber will reach 215° C - move to the laptop linked to the Photovac at that time;
- i) **when the desorber hits 220° C, a buzzer will sound – immediately hit "S" (for sample) or enter to run the sample (MUST BE WITHIN SECONDS);**
- j) slowly click the "**Step**" box on the laptop connected to the desorber until "**Standby**" is reached and then STOP;
- f) check the flow rate during the desorption, but do not adjust it;
- g) when the desorber has cooled to 80° C (about 15 minutes), the copper tube can be removed from the desorber and separated for cleaning (baking);
- h) click on "normal" to normalize the graph and examine the peaks for each analyte; record the _____ of each detected analyte on the breath analysis log sheet (the ppb information is not used); check that the names assigned to the peaks by the software program correspond to the timeframe in which the analyte is supposed to peak, i.e., _____ - _____ for benzene. If a peak occurs within one of the above referenced intervals but is unnamed by the laptop, record this information on breath analysis log sheet;
- i) save the breath analyte data for the sample in the Photovac breath analysis library;
- j) repeat the process for each breath sample.

Cleaning the Copper Tubes:

- a) place copper tubes on the cleaner's tube holders with the double-notched end of the tube up; fill the cleaner with tubes starting with holder # one and continue adding tubes in numeric order; note: holder number one must be filled.
- b) turn on the switches on that correspond to the tube holders which contain copper tubes; turn the remaining empty holder switches off.
- c) to open the high purity nitrogen gas supply line, lift up the handle on the copper gas line that feeds the tube cleaner unit;
- d) check the flow rate to each tube by connecting the flow meter; the flow rate should be 40 mm Hg;
- e) turn on the tube cleaner unit; switch from "**Check**" to "**Auto**"; the tubes will be baked (cleaned) in approximately 40 minutes; allow the unit to cool to approximately 80° C before removing the clean tubes for reuse.

E) Industrial Hygiene Sampling

Air Sampling: area sampling is to be conducted in worksites selected from among the areas where participants work on the basis of potential exposure to exhaust (xenoestrogen: polycyclic aromatic hydrocarbon) exposure. Area sampling will also be performed on an as needed basis whenever an "unusual" acute exposure occurs and can be measured at the time of its occurrence. WHAT ABOUT PERSONNAL SAMPLING? ARE THERE AREAS WHERE AN ACUTE EXPOSURE MAY BE POORLY CHARACTERIZED BY AREA SAMPLING?

Pump Calibration for Air Sampling: all pumps must be calibrated before and after air sampling in the "clean" office area, as follows:

- a) charge the battery packs each evening prior to work days; check and record the condition of the pumps;
- b) run the pumps for at least 10 minutes prior to calibration. Record the pump models and identifiers on the "Air Sampling Calibration Log" sheet;
- c) attach Tygon tubing to the pump and then remove the plugs and attach the calibration cassette, checking to see that the filter is correctly placed in the cassette;
- d) prepare the calibrator, wetting the surface of the buret by depressing the button several times; attach the calibrator to the dedicated calibration cassette and the pump to be calibrated using a short (constant) length of tygon tubing and the appropriate connector;
- e) adjust the nominal flow rate on the pump to 3.5 lpm using a fine screw driver;
- f) depress the button on the calibrator and note and record the value; repeat this step two additional times; the three readings must be within 10%; if the readings are within 10%, take the average of the three readings and record the average on the "Air Sampling Calibration Log Sheet"; if not, do not use the pump for sampling until the problem is discovered and corrected; often this is due to incomplete charging;
- g) shut off the pump and remove the calibration cassette to the next pump or seal it if all calibrations are complete.

Air Sampling:

- a) obtain the permission of the Shop Manager and/or BEE contact to sample a given area;
- b) place the pump in the area to be sampled in a location away from foot traffic but as near as possible to the site within which most work is performed; advise the Shop Manager of the pump's location;
- c) set the flow volume
- d) label the bag with identifying information, i.e., date, time sample collection started, location of sampling, sample number; flow rate and pump number;
- e) check the pumps hourly and record the time and flow rate on the "Air Sampling Log Sheet"; turn them off at the end of the sampling period;
- f) close and detach the Tedlar collection bags;

- g) empty the Tedlar bag of room air into copper tubes using the procedure described for breath analysis;
- h) analyze the air samples according to the method described for breath samples and record the results and identifying information on the "Air Sampling Log Sheet".

IH Pump Calibration

A) The following equipment will be needed for the sampling: (quantity)

1. Soap bubble calibrator with range of 0.2 to 5 lpm.
2. Personal pumps (PCXR8) with flow rates of about 4 lpm. (5)
3. Personal pumps with flowrates of 50-200 ml/minute (5)
4. Thermal Desorber tubes for JP-8 sample collection (16). Ten are for sampling, four are for field blanks and two will be labeled and used as a calibration tube. These tubes should be identified at random before the initial calibration.
5. Filter cassette blanks (9) and Teflon filters (9) with polypropylene web support and pore size of 0.45 micrometers and support pad for collection of total particulate samples. Five will be used for personal sampling, 1 will be used for area sampling, 2 will serve as field blanks and one will be identified and used as a calibrator for all pumps. The calibration cassette should be identified at random prior to calibration. The filters will be preweighed and coded by the lab prior to use.
6. Adjustable Low Flow Holders, with 2-4 valves (5).
7. Tygon tubing (10) 30" length
8. Tube splitter for VOC tube side, and Air Sampling tube side.
9. Collar clips (10)
10. Battery charger for the above.
11. Extra knit (Air Force Type) belts (5).

B) Calibration Procedure: All pumps will be calibrated prior to and after the sampling. Calibration should be done the morning of the sampling before the work begins. Calibration should be performed in an office away from the work site. Note that the charge condition of the battery packs must be affirmed the night before the sampling.

- 1) Completely charge battery pack of each pump the night prior to sampling. Charging will take approximately 14 hours. Check and record the condition of the pumps.
- 2) Run the pumps for at least ten minutes prior to calibration. Record the pump model and identifiers. Attach the tygon tubing to the pump and then remove the plugs and attach the calibration cassette checking to see that the filter is correctly placed in the cassette.
- 3) Prepare the calibrator, wetting the surface of the burette by depressing the button several times. Attach the calibrator to the dedicated calibration cassette

and the pump to be calibrated using a short (constant) length of tygon tubing and the appropriate connector.

- 4) Adjust the nominal flowrate on the pump to 3.5 lpm using a fine screwdriver.
- 5) Depress the button on the calibrator and note and record the value. Repeat this step 2 additional times. Take the average of the three readings. However, each reading must be within 10% of each other. This means that if the highest reading is 3.62 lpm, the lowest acceptable reading would be 3.26 lpm.
- 6) If the data are acceptable record the mean value, shut off the pump and remove the calibration cassette to the next pump or seal it if all calibrations are complete.
- 7) Calibration of the low-flow pumps is essentially the same except that the nominal flow should be set to about 0.2 lpm before calibration and that the designated calibration desorber tube should be used instead of the filter cassette. Again triplicate values should be obtained for each pump and the individual values must be within 10% of each other.
- 8) Post-sampling calibration is essentially the same procedure. See below.
- 9) If the data are out of range that pump should not be used for sampling until the problem is discovered and corrected. Often times this is due to incomplete charging.

Sampling and Post-Shift Calibration Procedures: Once all pumps have been calibrated they should be carried to the workfloor.

1. Check that each cassette and thermal desorber tube is numbered legibly.
2. Prepare the IH sampling data sheets. Assign a cassette and/or a desorber to a particular worker.
3. Affix the pump to the person's belt or ask the worker to wear one of the belts brought for that purpose and affix the pump to this. Behind the hip in the back is often the most comfortable location. Run the tygon tube up over the shoulder using either duct tape or small clamps to fix the tubing to the person's clothing in several places. Affix the cassette or desorber tube to the collar with the opening facing down. Remove and save all seals and closures.
4. Start the pumps and record the time to the minute. Ask the worker to state their name. Check the number of the collection media to be certain that the correct media and sample is being worn by the worker.
5. Advise the worker on the matter of checking if the pumps are still running, and how to contact the industrial hygienist in case the pumps turn off. Advise them to wear the pump their whole shift and at breaks and lunch if they remain in the work area for these.

If the workers leave their work area for lunch, a designated place for the storage of the running pumps must be provided and the workers instructed how to remove the pumps and place them into the storage space. This could be nothing more elaborate than a cardboard box. The workers may remove the pump during lunch, but they must be told not to shut the pumps off and be advised where to place them. If the workers are not to be wearing the pumps

during lunch, a place should be provided for temporary storage of the running pumps.

6. The industrial hygienist should remain in the work area(s) observing work practices and

making the notes of same on each person's IH data sheet.

7. At the end of the sampling period the pumps are turned off (time noted on the IH data sheets to the minute) and removed. Pumps and sampling media should then be moved to the office area.

8. Plugs should be replaced in all tubes and secured with tape. Sampling media should be placed

shipping containers consistent with the requirements of the analytical labs.

Pumps should be turned on and the post-shift calibration performed. The average post-shift calibration flow should be within 10% of the pre-shift value. If so, the average of the two values should be reported as the overall flowrate. If the flowrates are not within 10% of each other the sample is voided.

APPENDIX 4

MONDAY PRE-BREATH SAMPLE CHECKLIST ID _____

Record Time Samples Obtained: _____ Record Date: ____/____/____

1. In the PAST 24 HOURS, that is, since this time yesterday, have you had any of the following foods?.....IF YES, RECORD:

	Yes <input type="checkbox"/>	No <input type="checkbox"/>	# of Servings: _____	Eaten at (time): _____
a) Hamburger, cheeseburger, meatloaf	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
b) Hot dogs, lunch meat	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
c) Whole milk	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
d) Doughnuts, cookies, cake, pastry, pies	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
e) Other beef	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
f) Eggs	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
g) Cheese, cheese spreads (excluding cottage cheese)	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
h) Margarine or butter on bread rolls or on vegetables	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
i) Other pork	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
j) French fries, fried potatoes	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
k) Snacks such as chips, popcorn (exclude if low fat)	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
l) Bacon, sausage	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
m) Fried chicken	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____

2. Since your last breath sample on _____, did you...

- a)...use the self-service tank when refueling of your vehicle or lawn mower this week
(outside of work)? Yes ☐ No ☐ If yes, which date(s): ____/____/____; ____/____/____; ____/____/____
- b)...mow the lawn? Yes ☐ No ☐ If yes, which date(s): ____/____/____; ____/____/____; ____/____/____
- c)...breathe smoke from stoves, fireplaces or grills? Yes ☐ No ☐ If yes, which date(s): ____/____/____; ____/____/____; ____/____/____
- d)...eat any grilled/smoked/charred foods? Yes ☐ No ☐ If yes, which date(s): ____/____/____; ____/____/____; ____/____/____
- e)...use pesticides/insecticides, paints/solvents – this includes fingernail polish and polish remover? Yes ☐ No ☐ If yes, which date(s): ____/____/____; ____/____/____; ____/____/____

WORK WEEK PRE-BREATH SAMPLE CHECKLIST

ID _____

Record Time Left Work: _____ Record Date: ____/____/____

1. *In the PAST 24 HOURS, that is, since this time yesterday, have you had any of the following foods?.....* **IF YES, RECORD:**

	Yes <input type="checkbox"/>	No <input type="checkbox"/>	# of Servings: _____	Eaten at (time): _____
a) Hamburger, cheeseburger, meatloaf			_____	_____
b) Hot dogs, lunch meat			_____	_____
c) Whole milk			_____	_____
d) Doughnuts, cookies, cake, pastry, pies			_____	_____
e) Other beef			_____	_____
f) Eggs			_____	_____
g) Cheese, cheese spreads (excluding cottage cheese)			_____	_____
h) Margarine or butter on bread rolls or on vegetables			_____	_____
i) Other pork			_____	_____
j) French fries, fried potatoes			_____	_____
k) Snacks such as chips, popcorn (exclude if low fat)			_____	_____
l) Bacon, sausage			_____	_____
m) Fried chicken			_____	_____

2. *In the PAST WEEK, that is, one week ago today, did you...*

a)...use the self-service tank when refueling of your vehicle or lawn mower this week
(outside of work)? Yes ☐ No ☐ *If yes, which date(s):* ____/____/____; ____/____/____; ____/____/____

b)...mow the lawn? Yes ☐ No ☐ *If yes, which date(s):* ____/____/____; ____/____/____; ____/____/____

c)...breathe smoke from stoves, fireplaces or grills? Yes ☐ No ☐ *If yes, which date(s):* ____/____/____; ____/____/____; ____/____/____

d)...eat any grilled/smoked/charred foods? Yes ☐ No ☐ *If yes, which date(s):* ____/____/____; ____/____/____; ____/____/____

e)...use pesticides/insecticides, paints/solvents – this includes fingernail polish and polish remover? Yes ☐ No ☐ *If yes, which date(s):* ____/____/____; ____/____/____; ____/____/____

PLEASE REMOVE SHOES, HAT, JACKETS: HT: _____' _____" WT: _____

The following measures will help us to obtain accurate estimates of your fuel exposure at work. We would like you to follow them for **ONE WEEK**, i.e., *from the Monday before your first breath sample until the Monday morning of your final breath sample*.


- * **Avoid self-service refueling of your vehicle or lawn mower this week (outside of work).**
- * **Avoid mowing the lawn.**
- * **Avoid smoking sections of businesses and break rooms; try to lessen your exposure to cigarette smoke from friends and relatives as much as possible, especially indoors.**
- * **If you are an occasional smoker, please do not smoke until after the final (Monday) breath sample is provided.**
- * **Avoid smoke from fireplaces, grill-outs and grilled/smoked/charred foods**
- * **Avoid using pesticides/insecticides, paints/solvents – this includes fingernail polish and polish remover.**
- * **Please avoid using products containing alcohol. Especially, 24 hours prior to your breath sample, please do not use alcohol, mouthwash or cough syrup.**
- * **Even the best-laid plans sometimes go awry. If you are unable to avoid one or more of the exposures on this page, please tell us when you provide your breath sample. This will help us to interpret the results.**
- * **If you live with others, please ask them to read and, if acceptable, sign the form below. Bring the signed form with you when you arrive to provide your breath sample.**

TO OTHER MEMBERS OF THE HOUSEHOLD: *In order to obtain an accurate picture of the subject's internal exposure to fuel while at work, we need to enlist your help. During the week of testing, you can assist us in the following ways:*

Please protect her from exposure to smoke for one week during testing by:

- Helping her to avoid smoke from stoves, fireplaces or grilling food, even outdoors
- If you smoke, do so outdoors and please do not smoke when she is in the car with you
- Fuel-up the gas tank for her so she doesn't inhale the fumes
- If the lawn has to be mowed, fuel the lawn mower and mow the lawn for her
- Post-poner painting, spraying pesticides/insecticides or using solvents if she might be in the area and inhale the fumes

We realize these requests may cause some inconvenience. If you have any questions before you sign, please leave a phone message for Susan Simpson at (513) 558-0229. Include your name, phone number and days/times when you can be reached. IF YOU ARE WILLING TO PERFORM THESE MEASURES, PLEASE SIGN BELOW:

 _____

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INFORMED CONSENT

FEMALE REPRODUCTIVE EFFECTS OF EXPOSURE  
TO JET FUEL AT U.S. AIR FORCE BASES

University of Cincinnati Medical Center  
5251 Medical Sciences Building (ML 0182)  
PO Box 670182  
Cincinnati, Ohio 45267-0182

Institutional Study Number: 95-10-27-2

Sponsor Study Number: DAMD17-96-2-6015

Principal Investigator: Grace K. Lemasters, PhD, University of Cincinnati; ph # (513) 558-0030

Associates: James Lockey, MD, University of Cincinnati  
Col. John Joyce, Wright-Patterson AFB  
James Kesner, PhD, NIOSH  
Richard A. Henderson, III, MD

Field Location: Hill AFB, Luke AFB (additional AFBs to be named)

I. INTRODUCTION:

Before agreeing to participate in this study, conducted by the University of Cincinnati Department of Environmental Health, it is important that the following explanation of the proposed procedures be read and understood. It describes the purpose, procedures, benefits, risks, discomforts and precautions of the study. It also describes alternative procedures available and the right to withdraw from the study at any time. It is important to understand that no guarantee or assurance can be made as to the results. It is also understood that refusal to participate in this study will not influence standard treatment for me. My participation in this study is voluntary.

I, \_\_\_\_\_, have been asked to participate in the research study under the direction of Dr. Grace Lemasters and the medical supervision of Dr. James Lockey. Other professional persons who work with them as study staff may assist or act for them.

## II. PURPOSE:

The purpose of this study is to determine: (1) if Air Force women exposed to jet fuel have different hormonal patterns and menstrual function than unexposed women; 2) if there are differences between Caucasian and African-Americans in their reproductive health responses to jet fuel exposure.

## III. DURATION:

My participation in this study will last for approximately three months.

## IV. PROCEDURES

The study design involves selection of 100 African American and 100 Caucasian women who are currently in the Air Force, i.e. both civilian and military women, for recruitment based on their job titles. Exposure levels, reproductive history, symptoms and hormones level information will then be obtained from these women.

I have been told that during the course of the study, the following will occur: During an initial interview, I will be asked a series of questions about my work, reproductive and menstrual histories. In addition, I will be asked to keep a daily diary of my menstrual events to be mailed to the study coordinator weekly for three months. My social security number will be used to access records of my previous Air Force work history. I understand that I will be asked to wear an SKC, Inc. air sampling device weighing approximately 10 ounces used to collect samples of air in my work area. The sampling device will be positioned in my work area or worn over my clothing. It will be secured on my side with straps and a collar clip, so as not to interfere with my work, for a full eight hour shift. I will not be requested to perform any additional tasks outside of my regularly assigned duties. The equipment will remain in place through all breaks unless I leave the area of exposure. Upon my return it will be reattached. Investigators working with the University of Cincinnati will supervise this sampling procedure. Personal air sampling will take place once a week during a five-week period. In addition, over the five-week period, I will possibly be asked to provide four weekly breath samples. Work breath samples will be taken within two hours of the end of my shift. Home breath samples will be taken 4 to 8 hours weekly after work and on Monday morning before leaving for work. Breath samples will be obtained by breathing into a 1-liter Tedlar sample collection bags which will be provided to me. For the breath sample, I will hold a rubber mouthpiece and breathe through a valve attached to the mouthpiece. I will breathe through this system for several seconds per sample. I understand I must not smoke for 2 hours before the sample nor drink alcoholic beverages for 24 hours before each sample. I understand I will be asked to provide daily urine (about 6 teaspoonfuls) and saliva (about 3 teaspoonfuls) samples for analysis of hormones and cotinine over the five week period. These samples will be deposited by me into carrier boxes which will be kept in my home freezer during the collection period. I will then bring all samples to the study site. I will be participating in the protocol for approximately three months during which I will participate in the study for an estimated total of 60 hours performing the activities described above. If there is a significant variance from the stated time period, I will be notified. The results of the air and biological samples will be made available to me.

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## V. EXCLUSIONS:

I should not participate in the study if any of the following apply to me: I am over 40 years of age, I have been pregnant within the last three months, am currently pregnant, have breast-fed within the past three months, have used oral contraceptives within the last three months, had an intrauterine device (IUD) inserted within the last three months, am taking estrogen replacement or other hormone supplements. I understand that I cannot be included in the study if I have a history of endometriosis, chronic pelvic inflammatory disease, vaginal, cervical, uterine or ovarian cancer, systemic lupus erythematosus, hypopituitarism, Cushing's Syndrome, sarcoidosis, a pituitary tumor, acute hepatitis, HIV positive, cirrhosis of the liver, hypothyroidism (only if taking thyroid medication), hyperthyroidism, multiple sclerosis, tuberculosis confirmed by X-ray or sputum, diabetes, hysterectomy, removal of an ovary(ies) or if I smoke, on average, more than three cigarettes/cigars per day.

## VI. RISKS/DISCOMFORTS

I have been told there are no known risks associated with wearing a sampling device, providing biological samples or with any other study procedures described above. There also may be risks and discomforts which are not yet known.

## VII. PREGNANCY

If I should become pregnant while enrolled in this study, there is no known risk to me or my fetus by participation in this study.

## VIII. BENEFITS

I have been told that benefits of participating in this study may be improved knowledge of my personal exposures. This information may also benefit my co-workers, my employer and general medical/scientific understanding of potential exposures by providing information about my workplace.

## IX. CONFIDENTIALITY OF RECORDS

Every effort will be made to maintain the confidentiality of my study records. Agents of the United States Food and Drug Administration, the University of Cincinnati, the National Institutes of Safety and Health will be allowed to inspect sections of my medical and research records related to this study. The possibility also exists that authorized government agencies, such as the Department of Defense (DOD) and the United States Army Medical Research and Materiel Command (USAMRMC) may review records held by the University of Cincinnati as a part of their responsibility to protect human subjects in research. Complete confidentiality cannot be promised particularly to subjects who are military personnel because information bearing on my health may be required to be reported to appropriate medical or command authorities. If I am civilian or active duty military, all medical data and medical

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information obtained about me as an individual will be considered privileged and held in confidence. The data from this study may be published; however, I will not be identified by in any presentation of the results. My identity will remain confidential unless disclosure is required by law. Records of my participation in this study may only be disclosed in accordance with federal law, including the Federal Privacy Act, 5 U.S.C. 552a, and its implementing regulations. DD form 2005, Privacy Act Statement--Health Care Records, contains the Privacy Act Statement for the records. All information will be held in locked file cabinets. Study questionnaires, samples and computerized information will be labeled using a unique study number, not my social security number. When all study information, without individual identities, is analyzed for any abnormal trends, the results of the analysis will be made available to me.

#### X. FINANCIAL COSTS TO THE SUBJECT

Funds are not available to cover the costs of any ongoing medical care not associated with this research and I remain responsible for the cost of non-research related care. Tests, procedures or other costs incurred solely for purposes of research will not be my financial responsibility. If I have questions about my medical bill relative to research participation, I may contact Grace Lemasters, Ph.D.

#### XI. COMPENSATION IN CASE OF INJURY.

The University of Cincinnati Medical Center follows a policy of making all decisions concerning compensation and medical treatment for injuries occurring during or caused by participation in biomedical or behavioral research on an individual basis. If I believe I have been injured as a result of this research, I will contact Grace Lemasters, Ph.D. at (513) 558-0030 (between 0800 and 1500 hours) or (513) 553-7002 (after 1500); or Harry Rudney, Ph.D. at (513) 558-5517.

For Military Subjects: I understand that my entitlement to medical care or compensation in the event of injury are governed by federal laws and regulations, and if I desire further information I may contact Dr. Grace Lemasters, Ph.D. at (513) 558-0030.

#### XII. PAYMENTS TO PARTICIPANTS

I will not be compensated for initial study activities, e.g., completion of the informed consent and baseline questionnaire, as these will be completed in approximately two hours while I am on-duty. Payment will be made for study participation that occurs while I am off-duty. I have been told that I will receive \$100 for approximately 58 hours of off-duty study participation according to the following schedule: \$25 upon completion of the breath analysis/personal air sampling and industrial hygiene work activity log; \$25 upon receipt of saliva and final urine samples; \$50 after the return of all menstrual diary data.

For Military Subjects: In order to permit compensation for my off-duty study participation, my supervisor and I will sign Air Force Form 3902, i.e., "Application and Approval For Off-Duty Employment".

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### XIII. THE RIGHT TO WITHDRAW

I understand that my participation is voluntary and I may refuse to participate, or may discontinue my participation AT ANY TIME, without penalty or loss of benefits to which I am otherwise entitled. If I decide not to participate or to withdraw early from the study, no adverse action will be taken against me. I also understand that the investigator has the right to withdraw me from the study AT ANY TIME. I have been informed that no action will be taken against me by personnel from the University of Cincinnati or United States Air Force. Also, the decision to withdraw will not influence my current or future employment.

I understand that my withdrawal from the study may be for reasons related solely to me (eg., not following study-related directions from the Investigator) or because the entire study has been terminated. I understand the Sponsor has the right to terminate the study or the Investigator's participation in the study at any time.

### XIV. PARTICIPATION BY ACTIVE DUTY MILITARY PERSONNEL

I am aware that my military duties will take precedence over any obligations I have to the study, and that I may be reassigned to locations where participation is no longer possible. I will inform the Study Coordinator, Susan Simpson, (513) 558-0229, of changes in my duties or duty locations as soon as possible so that my continued participation can be evaluated.

### XV. AVAILABILITY OF INFORMATION

This study has been explained to my satisfaction and my questions were answered. If I have any other questions about this study, I may call Grace Lemasters, Ph.D. at (513) 558-0030 (between 0800 and 1500 hours) or (513) 553-7002 (after 1500). Between 9/8/97 and 9/22/97, questions may also be directed to the local point of contact, Donna Olsen, Ph.D at DSN # \_\_\_\_-\_\_\_\_ (between 0800 and 1630). Questions regarding my rights should be addressed to:

Harry Rudney, Ph.D., Chairperson  
Institutional Review Board  
125 Wherry Hall, M.L. 0567  
University of Cincinnati  
PO Box 670567  
Cincinnati, Ohio 45267-0567  
(513) 558-5517



XVI. IS THE SUBJECT CURRENTLY PARTICIPATING IN ANOTHER STUDY:

☐ Yes. If yes, please provide:

Principal Investigator's name \_\_\_\_\_

Title of the study \_\_\_\_\_

Institutional study # \_\_\_\_\_

Sponsor Study # \_\_\_\_\_

☐ No.

I HAVE READ THE INFORMATION PROVIDED ABOVE. I VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY. AFTER IT IS SIGNED, I WILL RECEIVE A COPY OF THIS CONSENT FORM:

\_\_\_\_\_  
Subject's Name Date

\_\_\_\_\_  
Subject's Signature Date

\_\_\_\_\_  
Permanent Address

\_\_\_\_\_  
Investigator Signature Date

\_\_\_\_\_  
Witness Signature Date

## CONSENT FOR URINE AND SALIVA SAMPLE DONATION

### FEMALE REPRODUCTIVE EFFECTS OF EXPOSURE TO JET FUEL AT U.S. AIR FORCE BASES

I voluntarily and freely donate any and all body fluid samples (urine and saliva) to the study sponsor, the University of Cincinnati, and relinquish all right, title and interest to said items. I understand there is a possibility that the body fluids or products which I am providing under this study may also be used in other health-related research studies, but will not be applied commercially. I understand that any future unnamed studies which make use of my body fluid samples would require prior approval by an ethical review panel, i.e., the University of Cincinnati Institutional Review Board. With this understanding:

PLEASE CHECK ONE:

- ☐ I agree to allow my body fluid samples (urine and saliva) to be used in unnamed future health-related studies only on the condition that all labels that identify me personally are removed and the results of future studies are not presented to me.
- ☐ I agree to allow my body fluid samples (urine and saliva) to be used in unnamed future health-related studies only on the condition that I am recontacted and informed about said future study(ies) and, at that time, give my informed consent.
- ☐ I **refuse** to allow my body fluid samples (urine and saliva) to be used in any future unnamed studies.

Participant Signature: \_\_\_\_\_ Date    /    /   

Witness Signature: \_\_\_\_\_ Date    /    /   

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